SHORT COMMUNICATION

Oryza Vol. 55 No. 2, 2018 (353-356)
DOI 10.5958/2249-5266.2018.00044.9

Potential use of some plant extracts against foot rot of rice (*Oryza sativa* L.)

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Received : 20 May 2015 Accepted : 17 March 2018 Published : 27 June 2018

ABSTRACT

In continuation of our ongoing efforts to search for plant based eco-friendly bio- protectant against diseases of cereal crops. 32 plants samples of 26 plants species were bio-assayed by measuring the mycelia growth inhibition of Fusarium moniliforme, a causal organism of foot rot of rice. The tested results showed a differential activity of the plant extracts against the mycelium growth. The combined fruit and stem extracts of Terminalia belerica in general showed a strong enhancement in activities over the individual fruit extracts of T. belerica and stem extracts of T. belerica against the mycelium growth. The root extracts of Salvadora persica and petal extracts of Rosa damascena also showed strong inhibitory effect against the tested fungi. The leaf and bark extracts of T. belerica, leaf extract of Tectona grandis, Mimosa hamata and petal extracts of Tagetes erecta showed appreciable good inhibitory effect against the tested fungi.

Key words: *Fusarium moniliforme, antifungal, plant-extracts, phytochemicals*

For the ever increasing world population require the production of huge quantities of rice but our efforts are hampered due to biotic as well as abiotic factors. Among the biotic factors various diseases caused due to phytopathogens are major hindrance in desired production of rice. The foot rot disease rice caused by Fusarium moniliforme is one of them and is widely spread in many rice growing areas resulting 3.7 - 70 percent yield loss in different countries (Bagga and Kumar, 1999). Generally synthetic fungicide *viz*., thiram is used in the management of fungal pathogens in agriculture (Bagga and Sharma, 2006) and its repeated or prolonged exposure responsible for acute toxicity and chronic toxicity in humans (Hayes and Laws, 1990). There is thus an urgent need to develop sustainable management methods for this important disease. The present study was undertaken to study the efficacy of plants extracts for their antifungal activity against foot rot caused by *F. moniliforme*.

Plant materials were collected from various parts of Haryana and its neighboring states on the basis of their traditional values (Table 1). The collected plant materials were thoroughly washed with tap water as well as distilled water and kept in dark in between the filter papers at room temperature (25°C-27°C) till completely dry. Each plant sample was individually grounded into powder for preparation of the extract. The fungus of *F. moniliforme* [IARI 4824(F)] used for the study was obtained from the Division of Plant Pathology, IARI, New Delhi. The cultures were maintained at 4°C in refrigerator on Yeast Glucose Agar medium with periodic sub-culturing.

The plant part extract (15% w/v) was prepared by brewing in hot water. 15g dry powder of each plant sample was weighed and put in a cheesecloth bag and suspended in 100 ml of boiling distilled water for 20 minutes. The extract was allowed to stand for some time and decanted off into the flask and final volume was raised to 100ml by adding boiled distilled water. The supernatant was used for assay. The antifungal activity of each plant part extract was determined by measuring the mycelia growth inhibition of tested fungi as described by Bragulat et al. (1991). A known volume of 15% plant sample extract was supplemented with

Table 1. Common names and families of plants used in experiment.

Sr. No.	Botanical Name	Common Name	Name of Family
1.	*Lawsonia alba* (L.)	Mahendi	Lythraceae
2.	*Mimosa hamata* (Willd.)	Aill	Mimosaceae
3.	*Nerium oleander* (L.)	Pili Kaner	Apocynaceae
4.	*Ocimum sanctum* (L.)	Tulsi	Labiatae
5.	*Phoenix dactylifera* (L.)	Khajur	Palmae
6.	*Phoenix rupicola* (L.)	Desi Khajur	Palmae
7.	*Physalis minima* (L.)	Papotan	Solanaceae
8.	*Plumeria alba* (L.)	Champa	Apocynaceae
9.	*Pongamia pinnata* (L. Mirr.)	Papari	Leguminosae
10.	*Psidium guajava* (L.)	Amrood	Myrtaceae
11.	*Pterospermum acerifolium* (Willd.)	Kanak Champa	Sterculiaceae
12.	*Quisqualis indica* (L.)	Rangoon-Ki-Bel	Combretaceae
13.	*Ricinus communis* (L.)	Arand	Euphorbiaceae
14.	*Rosa damascena* (Mill.)	Gulab	Rosaceae
15.	*Salvadora persica* (Garc.)	Jal	Salvadoraceae
16.	*Sida cordifolia* (L.)	Kangi	Malvaceae
17.	*Solanum nigrum* (L.)	Makoi	Solanaceae
18.	*Strebelus asper* (Lour.)	Ohoba	Moraceae
19.	*Tagetes erecta* (L.)	Gendha	Compositae
20.	*Tamarix gallica* (L.)	Jhau	Tamaricaceae
21.	*Tectona grandis* (L.f.)	Teak	Verbenaceae
22.	*Terminalia arjuna* Wight.and Arn.	Arjun	Combretaceae
23.	*Terminalia belerica* (Roxb.)	Baheda	Combretaceae
24.	*Thevetia nerifolia* (Roxb.)	Pili Kaner	Apocynaceae
25.	*Tribulus terrestris* (L.)	Bhakhri	Zygophyllaceae
26.	*Vernonia anthelmintica* (Willd.)	Sahdei	Compositae

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 disc of (0.65cm) in diameter was 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 under sterilized conditions. The experiments were conducted in triplicates along with equal number of controls. The fungus was incubated at 27 ± 1ºC 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 test fungus (control), T = Diameter of test fungus.

Assay for antifungal activity of combined plant samples. The sample of each plant was prepared as explained earlier. The selected plants extracts were combined in the ratio 1:1. Assay for the antifungal activity of the combined extracts was carried out by the food poisoning method (Bragulat et al., 1991).

The activity of the plant extracts against the mycelium growth of *F. moniliforme* was presented in table 2. It was observed that out of various extracts tested, all parts of *Terminalia belerica* have shown varied inhibitory effect against test fungi. The fruit extracts of T. belerica showed maximum inhibitory effect (71.61%) against the mycelium growth of *F. moniliforme* followed by stem extracts of *T. belerica* (53.16%). The root extracts of Salvadora persica (52.94%) and petal extracts of Rosa damascena (50.00%) were also observed to show strong inhibitory effect against the growth of F. moniliforme. Five plants samples showed moderate inhibitory effect against the mycelium growth of test fungus *i.e.,* leaf extracts of *T. belerica* (49.57%), bark extracts of *T. belerica* (49.13%), leaf extracts of *Tectona grandis* (42.70%), leaf extracts of *Mimosa hamata* (39.93%) and petal extracts of *Tagetes erecta* (38.37%), while seventeen plants have shown insignificant inhibition of mycelium growth against the test fungus. Five plants samples, however, did not show any inhibitory activity. The mixtures of fruit and stem extracts of *T. belerica* (78.64%) showed maximum inhibitory activity as

Table 2. Anti-fungal activities of plants-extracts against *Fusarium moniliforme*.

Sr. No.	Plant species	Part Used	Percentage Inhibition of Mycelium Growth (Mean ± SD)
1.	*Lawsonia alba* (L.)	Stem	20.93 ± 1.14
2.	*Mimosa hamata* (Willd.)	Leaf	39.93 ± 1.32
3.	*Nerium oleander* (L.)	Leaf	---
4.	*Ocimum sanctum* (L.)	Seed	9.68 ± 1.32
5.	*Phoenix dactylifera* (L.)	Stem	---
6.	*Phoenix rupícola* (L.)	Seed	16.86 ± 1.62
7.	*Physalis minima* (L.)	Leaf	5.98 ± 1.68
8.	*Plumeria alba* (L.)	Leaf	5.13 ± 2.14
9.	*Pongamia pinnata* (L. Mirr.)	Seed	16.67 ± 1.68
10.	*Psidium guajava* (L.)	Fruit	23.00 ± 1.34
11.	*Pterospermum acerifolium* (Willd.)	Seed	8.11 ± 1.86
12.	*Quisqualis indica* (L.)	Leaf	---
13.	*Ricinus communis* (L.)	Leaf	24.72 ± 1.42
14.	*Rosa damascena* (Mill.)	Petal	50.00 ± 0.98
15.	*Salvadora persica* (Garc.)	Root	52.94 ± 0.46
16.	*Sida cordifolia* (L.)	Seed	2.40 ± 1.54
17.	*Solanum nigrum* (L.)	Leaf	5.00 ± 2.82
18.	*Strebelus asper* (Lour.)	Leaf	2.18 ± 1.42
19.	*Tagetes erecta* (L.)	Petal	38.37 ± 1.66
20.	*Tamarix gallica* (L.)	Inf.	---
21.	*Tectona grandis* (L.f.)	Leaf	42.70 ± 1.22
22.	*Tectona grandis* (L.f.)	Seed	24.88 ± 1.82
23.	*Terminalia arjuna* Wight.and Arn.	Seed	14.93 ± 2.34
24.	*Terminalia belerica* (Roxb.)	Bark	49.13 ± 0.88
25.	*Terminalia belerica* (Roxb.)	Fruit	71.61 ± 0.74
26.	*Terminalia belerica* (Roxb.)	Leaf	49.57 ± 1.12
27.	*Terminalia belerica* (Roxb.)	Stem	53.16 ± 1.24
28.	*Thevetia nerifolia* (Roxb.)	Leaf	18.32 ± 1.74
29.	*Thevetia nerifolia* (Roxb.)	Pod	2.64 ± 1.86
30.	*Tribulus terrestris* (L.)	WP	8.99 ± 2.82
31.	*Vernonia anthelmintica* (Willd.)	Leaf	---
32.	*Terminalia belerica*	(Fruit) + (Stem)	78.64 ± 0.28

compared to the individual extracts (Table 2).

Considering the need for an alternative eco-friendly approach to control the phytopathogens, it was believed to be worthwhile to screen the antifungal effects of locally available flora. The results of this study are indicating of the differential activities of the plant extracts on the mycelium growth of *F. moniliforme* because many of these extracts have shown very strong inhibition against the mycelium growth of tested fungi and a definite potential for new effective fungicides.

The study reveals that the various parts *i.e.,* bark, fruit, leaf and stem of *Terminalia belerica* have shown a wide range of inhibitory effect against test fungus. Out of these the fruit extracts shown marvelous inhibitory effect against the mycelium growth of *F. moniliforme*, which might be due to the presence of some antimicrobial phytochemicals. The plant *Salvadora persica*, *Rosa damascena*, *Terminalia belerica*, *Tectona grandis*, *Mimosa hamata* and *Tagetes erecta* possess various medicinal properties (Usher, 1971; Bhakuni et al., 1971; Dixit et al., 1975; Singh and Sharma, 1978; Abraham et al., 1986; Pandey, 1993; Aswal et al., 1996; Ahmad and Beg, 2001), hence, the spray of their extracts could be used for protecting plants against *F. moniliforme* instead of synthetic chemicals.

The mixture of fruit + stem extracts of Terminalia belerica showed a strong enhancement in activities over the individual extracts of fruit and stem extracts of *T. belerica* respectively against the mycelium growth. This enhancement in activity of the combined extracts was manifested in two ways. Firstly, the combined extracts showed greater activity against the individual fungi as compared to the individual plants.

Secondly, it was also observed that the combined extracts had a greater spectrum of activities against the various fungi as compared to the individual plant extracts. Possible reasons for enhancement may be due to: (a) Greater concentration of the various groups of botano-chemicals than in case of individual extracts due to additive effect of the extracts. (b) Greater diversity of the various groups of botano-chemicals due to supplementation by one or the other plant extracts. (c) The possibility of synergistic effect of the phytochemicals cannot be ignored. Therefore, the spray of the combined fruit and stem extracts of Terminalia belerica could be used for protecting paddy crops against pathogenic organisms *F. moniliforme* and a strong substitute of synthetic chemicals.

The antimicrobial activities of plants studied have also been found registered in various literature, Lawsonia alba (Ganesan et al., 2004), Psidium guajava (Chopra et al., 1992) and Ricinus communis (Abraham et al., 1986).

Since the extracts of Lawsonia alba, Mimosa hamata, Psidium guajava, Ricinus communis, Rosa damascena, Salvadora persica, Tectona grandis, Terminalia belerica and Tagetes erecta including the combined fruit and stem extracts of Terminalia belerica used in this study have not been tested before as inhibitor of this phytopathogenic fungus, therefore, they are the new addition to this field of study. The presence of various secondary metabolites such as alkaloids, quaternary alkaloids, coumarins, flavanoids, steroids/ terpenoids, phenols etc. have been reported in the various plants extracts (Aswal et al., 1984; Abraham et al., 1986; Chopra et al., 1992) which may be responsible for the antifungal properties of the plant studied.

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