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Effect of plant extracts on spore germination and severity of post harvest rots of fruits

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Abstract

Due to the environmental pollution, residue in soil water and food materials and effect on non-target organism, the use of chemical fungicides for disease management is being discouraged in the present day crop production. The opening-up of the global economy has enhanced the possibility of fruit-export. The fruit-exporting countries have strict requirements to meet health standards. These requirements have adversely affected the fungicide application on harvested fruits. Fortunately, the search for alternative treatments has yielded positive results with heat, plant extracts, radiation and some chemicals. Of these strategies, the use of plant extracts has proved safer and effective against certain diseases of harvested fruits. This investigation reports findings on efficacy of leaf extracts of *Tulsi* , *Sadabahar* , *Parthenium* , *Turmeric* and *Ginger* against important fruit rots of mango and citrus fruits. Application of leaf extract of *Tulsi* (10%) reduced disease severity and spore germination of Rhizopus rot, Penicillium rot and Botryodiplodia rot of mango and citrus fruits.

Key words: *Spore germination, post harvest rots, tulsi, Parthenium*

Introduction

Natural compounds have been used traditionally to preserve food in India (Singh *et.al.*, 1980), and other countries. Plant contains a variety of fungicidal compounds. Antifungal activity in leaf extracts have been reported by various investigators (Pathak & Jain, 1970). Babu & Reddy (1986) have reported that extracts of *Eucalyptus globulna, Punica granatum, Lawsonia inumis* and *Datura stramonium* were effective in checking fruit rot of lemon. Hasabnis & D'souza (1987) obtained best reduction in post-harvest storage rot by dipping mango fruits in garlic bulb extract or neem leaf extract. *Tulsi* leaf extract was found to reduce spore germination, growth, total proteins and pectinolytic and cellulolytic enzymes of various rot pathogens (Patel, 1991; Patil, 1992; Vyas, 1993 and Godara and Pathak, 1995). The extract can be processed to serve as an alternative to synthetic fungicides. It is estimated that less than 1% of the plants have been screened for antimicrobial activity. Ark and Thompson (1959) demonstrated that aqueous and organic solvent extracts of garlic contained potent fungicidal and bactericidal activity against several plant pathogens. They controlled post- harvest brown rot of peaches by dipping the fruit in an odourless garlic extract.

Materials and Methods

Leaf extracts of five plants viz. *Tulsi* (*Ocimum sanctum*), *Parthenium* (*Parthenium hysterophorus*), *Sadabahar* (*Vinca rosea*), *Ginger* (*Zingiber officinale*) and *Turmeric* (*Curcuma longa*) at 10 per cent (w/v) along with control treatments were tested against Rhizopus rot and Botryodiplodia rot of mango fruit and Penicillium rot and Botryodiplodia rot of sweet orange harvested fruits. Leaves and rhizomes were first washed with sterile distilled water and then air-dried, weighed plant material was crushed in warring blander and sterile distilled water (10 per cent = 1 gram plant material plus 9 ml sterile distilled water) was added. The material was homogenized for 5 minutes and the mixture was filtered through muslin cloth followed by filtration through Seitz filter.

Effect on spore germination

One drop of plant extract was mixed with a drop of spore suspension (10^6 spore/ml) on glass slide. The spore suspension was prepared in extract of ripe fruits. The slide was placed in an inverted position in a petri dish humid chamber. The slides were incubated at 28 ± 2^0C. Per cent spore germination was recorded after 24 hours in incubation. To assess spore germination, the slide was taken out, a drop of lactophenol was added to the spore suspension and per cent germination was assessed under the microscope. Each treatment was replicated three times.

Effect on disease severity

Mango and sweet orange fruits of nearly equal size harvested from orchards were brought to the laboratory. Fruits were surface sterilized and separately inoculated with each pathogen by prick-injury method. The injured and control fruits were surface sterilized and then separately inoculated with *Rhizopus arrhizus* and *Botrydiplodia theobromae* of mango *penicillium italicum* and *Botrydiplodia theobromae* of sweet orange by dipping them in spore suspension (10^6 spores/ml for 2 minutes)

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then treated with the plant extract for 5 minutes. The fruits were than air dried for 15-20 minutes. One fruit was accommodated in one bag. A piece of sterilized, wet, absorbent cotton was placed inside the bag and month of the bag loosely tied. The bagged fruits were kept at 28 2^0 C and 80-100 per cent RH. There were 20 fruits in each treatment. The disease severity was recorded on the basis of fruit area infected. This was assessed with the help of an assessment key devised for this purpose.

Results and Discussion

Effect on spore germination and severity of *Rhizopus arrhizus* and *Botryodiplodia theobromae* of mango fruits

Spores of both the rots started germination with in 6 hours in all the treatment of all the plant extract tested; only *Tulsi* extract proved effective against spore germination of both the pathogens after 24 hours of incubation. Significantly lowest disease severity of Rhizopus rot was recorded in fruits treated with *Tulsi* extract which was at par with severity in *Sadabahar* extract. In case of Botryodiplodia rot, significantly lowest severity was recorded in *Tulsi* extract treated fruits, which was at par with the severity in fruits treated with Sadabahar extract (Table 1). Similar results were also reported by Pandey *et al.* (1983) that leaf extracts of *Azadirachta indica* and *Ocimum sanctum* have been found effective against *Pestalotiopsis psidii*. However, Saks and Barkai-Galan (1995) reported that gel derived from Aloe-vera plants has been found to have antifungal activity against four common post-harvest pathogens : *Penicillium digitatum, P. expansum, B. cinerea* and *A. alternata*. The natural gel suppressed both germination and mycelial growth, with *P. digitatum* and *A. alternata* being the most sensitive species. The antifungal potential of the gel in decay suppression was exhibited on *P. digitatum* inoculated grapefruit, and was responsible for delay in lesion development as well as a significant reduction in infection process at shelf life conditions.

Effect on spore germination and severity of *Penicillium* rot and *Botryodilodia* rot of sweet orange fruits

Tulsi leaf extract proved highly effective against spore germination at 24 hours of incubation. *Tulsi* extract rendered significantly lowest severity against both the rots (Table 2).

In view of environmental pollution and the associated health hazards as well as the development of fungicide resistant strains of the pathogen, the emphasis is now gradually shifting from synthetic fungicides to natural products for management of various plant diseases. Hasabnis and D'souza (1987) obtained best reduction in post harvest storage rot by dipping mango fruits in garlic bulb extract or neem leaf extract. The results of present investigations corroborate with the findings of Meena (2006) who reported the efficacy of *Aloe barbadensis* leaf extract against spore germination of *Pestalotiopsis palmarum* and also rendered lowest severity of the rot of guava followed by *Ocimum sanctum* and *Azadirachta indica* leaf extracts. Similar observations were reported by Godara and Pathak (1995) who also observed that *Ocimum sanctum* leaf extract was highly effective against conidial germination and disease severity of *Penicillium italicum* and *B. theobromae* causing fruit rots of sweet orange. The present results also get support from the observations of Kumar (2002) who reported that the leaf extracts of *Azadirachta indica, Ocimum sanctum* provided effective control in pre-and post-inoculation treatment of *Alternaria* and *Aspergillus* fruit rots of ber.

In the present investigation, *Tulsi* extract was found to exert maximum inhibitory effect on germination of spores of the rot pathogens. The extract also proved highly effective against various rots of fruits. It appears that

Table 1. Effect of plant extract on spore germination and severity of *Rhizopus arrhizus* and *Botryodiplodia theobromae* of mango fruits

Plant extract (10 per cent)	Per cent spore germination after 24 hours		Severity (%)	
	R. arrhizus	*B. theobromae*	*R. arrhizus*	*B. theobromae*
Leaf extract of *Tulsi*	32.83	33.95	33.33	32.41
	(29.44)	(31.27)	(30.19)	(28.73)
Leaf extract of *Parthenium*	63.78	37.23	42.54	36.76
	(80.51)	(36.67)	(45.72)	(35.82)
Leaf extract of Sadabahar	34.59	37.89	37.40	35.52
	(32.31)	(37.84)	(33.55)	(33.75)
Rhizome extract of *Ginger*	46.93	38.61	41.41	42.07
	(53.39)	(39.24)	(43.75)	(44.90)
Rhizome extract of *Turmeric*	44.12	48.04	39.74	37.99
	(48.49)	(55.31)	(40.86)	(37.88)
Control	79.56	58.19	56.77	49.02
	(96.52)	(72.20)	(69.96)	(57.00)
SEm	0.55	1.06	2.90	1.30
CD at 5%	1.66	3.15	7.62	3.70

Figures in parentheses are retransformed values

Table 2. Effect of plant extract on spore germination and severity of *Penicillium* rot and *Botryodiplodia* rot of sweet orange fruits

Plant extract (10 per cent)	Per cent spore germination after 24 hours		Severity (%)	
	R. arrhizus	*B. theobromae*	*R. arrhizus*	*B. theobromae*
Leaf extract of *Tulsi*	47.49 (54.33)	42.91 (46.36)	28.45 (22.72)	26.63 (20.10)
Leaf extract of *Parthenium*	51.29 (60.78)	52.23 (62.44)	35.97 (34.50)	34.73 (32.48)
Leaf extract of Sadabahar	48.90 (56.78)	42.30 (45.28)	32.51 (29.91)	29.50 (24.27)
Rhizome extract of *Ginger*	55.68 (68.18)	59.16 (73.72)	40.80 (42.71)	31.99 (28.08)
Rhizome extract of *Turmeric*	54.71 (66.57)	55.68 (68.16)	37.70 (37.48)	34.15 (31.53)
Control	74.39 (92.51)	71.06 (89.35)	49.10 (57.11)	42.88 (46.28)
SEm	0.66	0.50	0.33	0.30
CD at 5%	1.87	1.44	0.97	0.88

Figures in parentheses are retransformed values

Tulsi (accorded highest religious honour in Hindu mythology) can serve as an important source of antimicrobial compounds. The anti-rot properties of this plant deserve in-depth investigations for its proper exploitation in fruit rot management.

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