Management of basal stem rot disease of *Areca catechu* L. in India

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Abstract

Basal stem rot caused by *Ganoderma lucidum* (Curtis Ex. Fr.) Karst is one of the dreaded diseases of arecanut. Pure cultures (16 nos.) of *Ganoderma* isolates were established from fruiting body, bark and root samples collected from Kerala, Karnataka, Tamil Nadu, Assam and West Bengal, the five areca growing states of India. Isolations made from the center of the fresh fruiting body were found to be better for obtaining pure cultures of *Ganoderma*. Standard aqueous leaf extracts of forty-three plant species were screened against the pathogen under *in vitro* conditions by poisoned food technique. *Allium sativum* extract completely inhibited the growth of the pathogen. Fresh leaf extract of *Peperomia pellucida* exerted 91.66 per cent inhibition followed by that of *Clerodendron infortunatum* (80.7%) and *Musa paradisiaca* (43.45%) at 96 h. Four fungal cultures *viz*., an unidentified sterile white fungus (77.8), *Trichoderma harzianum* (72.2), *T. viride (62.0)*, and *Penicillium* sp. (42.0) were found to be inhibitory on the mycelial growth of the pathogen at 96 h.

Key words: *Ganoderma* spp., biological control, botanicals, antagonists, arecanut basal stem rot

Introduction

The arecanut palm, *Areca catechu* L. is the source of common masticatory nut, popularly known as arecanut, betel nut or 'supari'. It is extensively used in India by all sections of the people as a masticatory, and is an essential requisite for several religious and social ceremonies. Consequently, the arecanut palm occupies a prominent place among the cultivated crops in the states of Kerala, Karnataka, Assam, Meghalaya, Tamil Nadu and West Bengal and is of considerable economic and socio-religious importance for the entire country.

Arecanut palm is affected by a number of diseases during different stages of its growth and development. Basal stem rot of arecanut caused by *Ganoderma lucidum* (Curtis ex. Fr.) Karst is one of the dreaded diseases of arecanut. It has not only affected the productivity but has also wiped out areca plantations in certain localities. Occurrence of this disease in Karnataka was reported as early as 1807 (Buchanan, 1807). The disease has also been reported from Tamil Nadu, Kerala and Assam (Anonymous, 1960), Bengal (Sharples, 1928) and Nicobar Islands (Sangal *et al.,* 1961). Foliar symptoms of the disease appear as yellowing of leaves in the outer whorls, which gradually extends to the inner whorls. These leaves later droop down. The affected palms exhibit brownish patches at the base of the trunk. Often a brownish gummy exuadate comes out of these patches. 'Anabe' or fruiting body (basidium) of the fungus develops just above the soil level prior to the wilting or just after the death of the palm (Vijayan *et al.,* 1973). In some cases, fruiting bodies appear at the base of the living palm as well. Although control measures using fungicides are reported to be effective (Nambiar and Nair, 1973, Kumar and Nambiar,1990), it becomes very difficult for large-scale adoption. Therefore, it is necessary to go in for an integrated approach using biological pesticides and need based safer fungicides. Keeping this in view, the present investigation was undertaken to collect and isolate the pathogen from different localities to study the extent of variability and to conduct *in vitro* screening of botanicals and antagonistic organisms against the pathogen.

Materials and Methods

Survey was undertaken in four taluks of Tumkur

district of Karnataka, seven districts of Kerala, two districts of Tamil Nadu and one district each of Assam and West Bengal (Table. 1). Fruiting bodies, bark portions and roots were collected from the basal stem rot affected palms. The diseased samples were cut into small convenient pieces, sterilized in 0.1% $HgCl_2$ for two minutes, washed thrice in sterile distilled water and plated on the medium. Three media *viz*; Waksman's agar medium, Potato Dextrose Agar and Malt extract were used. The plates were incubated at 20°C for three days. Isolations of antagonistic organisms also were attempted from the soil samples collected from different locations.

Table 1 Details of samples collected

Location	No of samples
Assam	
Kamup	11
Karnataka	
Hirehalli	1
Sire	22
Tumkur	8
Vittal	1
Kerala	
Kannur	4
Kasaragod	1
Kozhikode	1
Malappuram	1
Thrissur	1
Wayanad	1
Tamil Nadu	
Coimbatore	2
Salem	10
West Bengal	
Jalpaiguri	7

Commonly found plant species from the arecanut garden were collected and tested for their property of inhibition. Standard aqueous leaf extracts (1g/ml) of forty-three commonly occurring plant species were screened against the *Ganoderma* isolate G3 under *in vitro* conditions by poisoned food technique (Bhaskaran *et al.,* 1988). One hundred grams of plant tissue were extracted with hundred ml of distilled water and filtered through double-layered muslin cloth. The filtrate was added to Waksman's agar media to give one litre of the medium and was autoclave sterilized.

Results and Discussion

Sixteen isolates were obtained from the collected samples (Table. 2). Fresh fruiting bodies were found to be better source for isolation than the others. The most suitable medium for isolation was Waksman's agar compared to other media tested *viz*. Potato dextrose agar and malt extract agar. Isolates G_1, G_2, G_3, G_9, G_{10}, G_{11} G_{12} and G_{16} were obtained from fruiting bodies of *Ganoderma* occurring on the arecanut palm grown as monocrop. G_4 and G_5 were collected from the roots. G_6 and G_7 were obtained from root, bark and fruiting body. The source palms were components of mixed cropping system. G_{13}, G_{14} and G_{15} were isolated from root and fruiting body of the palm grown in High Density Multi-Species Cropping System (HDMSCS).

Table 2: Details regarding isolations

Isolate No.	Location	Cropping system	Source of isolation
G_1	Gullur, Tumkur Dt, Karnataka	Monocrop	Fruiting body
G_2	Kallambella, Tumkur Dt, Karnataka	Monocrop	Fruiting body
G_3	Ramalingapur, Tumkur Dt, Karnataka	Monocrop	Fruiting body
G_4	Hosahalli, Tumkur Dt, Karnataka	Monocrop	Root
G_5	Hagalwedi, Tumkur Dt, Karnataka	Monocrop	Root
G_6	Akkikkavu, Thrissur Dt, Kerala	Mixed cropping	Root, Bark and fruiting bdoy
G_7	Kanjileri, Kannur Dt Kerala	Mixed cropping	Fruiting body, Root & bark
G_8	Thalikadu, Kannur Dt, Kerala	Mixed cropping	Fruiting body
G_9	Salem, Salem Dt Tamil Nadu	Monocrop	Fruiting body
G_{10}	Pady,Kasaragod Dt, Kerala	Monocrop	Fruiting body
G_{11}	Hirehalli, Tumkur Dt Karnataka	Monocrop	Fruiting body
G_{12}	Vittal, Dakshina Kannada Dt Karnataka	Monocrop	Fruiting body
G_{13}	Kamrup Dt, Assam	*HDMSCS	Root
G_{14}	Kamrup Dt, Assasm	*HDMSCS	Root
G_{15}	Kamrup Dt, Assam	*HDMSCS	Fruiting body
G_{16}	Jalpaiguri Dt, West Bengal	Monocrop	Fruiting body

* High Density Multi Species Cropping System

Four fungal cultures isolated from soil, are found to be inhibitory on the mycelial growth of the pathogen (Table. 3). AF1, a white coloured sterile fungus (yet to be identified) showed the maximum degree of inhibition

(69.74) followed by *Trichoderma harzianum* (67.88), *T. viride* (60.01) and *Penicillium* sp. (41.33).

Table 3. ***In vitro*** **evaluation of antagonistic organisms against** ***Ganoderma***

Antagonistic organism	Percent inhibition over the control			
	48 h.	72 h.	96 h.	Mean
Trichoderma harzianum	60.00	71.42	72.22	67.88
Trichoderma viride	56.52	61.53	62.00	60.01
Penicillium sp.	40.00	42.00	42.00	41.33
AF1 (yet to be identified)	60.00	71.43	77.8	69.74

Table 4: Effect of plant extracts on the mycelial growth of ***Ganoderma***

Leaf extract	48h.	72h.	96h.	Mean
Adathoda vasica	5.20	5.20	5.60	5.30
Ageratum conyzoides	0.00	11.11	4.5	5.20
Allium sativum	100	100	100	100
Andrographis paniculata	0.00	11.132	23.45	11.52
Bougainvillea spectabilis	1.00	1.45	1.75	1.40
Calopogonium mucunoides	23.77	26.66	26.66	25.69
Calotropis indica	0.0	12.11	6.50	6.20
Cassia marginata	0.0	0.0	0.0	0.0
Clerodendron infortunatum	79.77	80.69	80.00	80.15
Cyclea peltata	0.0	0.0	0.0	0.0
Cynodon dactylon	0.0	0.0	0.0	0.0
Cyperus rotundus	2.11	2.11	2.69	2.30
Eupatorium odoratum	8.90	8.90	8.90	8.90
Gycosmis pentaphyla	5.60	5.90	5.90	5.80
Heliotropium scabrum	2.20	2.60	2.60	2.46
Hyptis suaveolens	0.0	0.0	0.0	0.0
Lantana camara	0.0	0.0	0.0	0.0
Lawsonia inermis	5.20	5.20	5.60	5.30
Leucas aspera	3.80	3.80	3.80	3.80
Melastoma malabathricum	0.00	14.28	15.28	9.88
Mimosa invisa	0.00	0.00	0.00	0.00
Musa paradisiaca (Mysore)	27.00	27.00	27.00	27.00
Musa paradisiaca (Kadali)	56.43	46.80	27.14	43.45
Musa paradisiaca(Mondan)	28.43	22.34	21.00	23.92
Mycaenia sp.	43.43	42.00	42.00	42.45
Nephrolepis exaltata	0.00	7.69	14.28	7.32
Nerium odoratum	5.20	4.90	4.90	5.00
Ocimum sanctum	8.11	8.77	8.68	8.52
Ocimum sanctum (N.E.)	28.57	30.76	36.57	31.96
Peperomia pellucida	100	100	75	91.66
Phyllanthus niruri	0.0	0.0	0.0	0.0
Piper nigrum	14.28	15.38	37.07	22.24
Plumbago zeylanica	0.0	0.0	0.0	0.0
Polyalthia longifolia	2.69	3.45	3.28	3.14
Polycarpaea aurea	0.0	0.0	0.0	0.0
Scoparia dulcis	0.0	11.13	23.45	11.50
Sida cordifolia	8.20	8.20	8.60	8.3
Solanum indicum	0.00	7.69	23.80	10.50
Wedelia trilobata	46.09	42.00	40.00	42.69
Strychnos nux-vomica	39.77	40.66	41.69	40.70
Tinospora cordifolia	2.69	3.45	3.28	3.14
Vernonia cineria	0.0	0.0	0.0	0.0
Vitex negundo	2.11	2.45	2.45	2.33

Among forty-three plant extracts, garlic extract (*Allium sativum*) completely inhibited the growth of the pathogen (Table. 4). *Peperomia pellucida* exerted 91.66 percentage of inhibition followed by *Clerodendron infortunatum* (80.15), *Musa paradisiaca* [Variety-Kadali] (43.45), *Wedelia trilobata* (42.69) and *Ocimum sanctum* (31.96). The extract of *A. sativum, P. pellucida, C. infortunatum* and *M. paradisiaca* were screened against antagonistic organisms under *in vitro* condition by poisoned food technique. Only garlic extract completely inhibited the growth of the antagonistic organisms. Earlier, Bhaskaran *et al.,* (1988) reported that neem cake extract completely inhibited the growth of *Ganoderma* isolated from coconut. Further they observed that banana rhizome extract and *Tephrosia purpurea* root extracts gave 86 and 54 per cent inhibition respectively. From the present study, it may be concluded that aqueous leaf extract of *P. pellucida, C. infortunatum, M. paradisiaca, W. trilobata* and *O. sanctum* can be used for managing the basal stem rot disease of arecanut caused by *Ganoderma* spp. in endemic areas. The advantage of this technique is that it is user-friendly and does not demand very high technical skills. The source plants except garlic, are commonly occurring weeds and are present in abundance. Since the extractant is water, this technique could be cost effective also. All the promising plant extracts except garlic, are compatible with antagonistic organisms. Results thus indicated that antagonistic organisms and plant extracts could be tested as compatible components in an IDM package.

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