



# Etiology and management of coconut basal stem rot (*Ganoderma* wilt) in sandy soils of Karnataka

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## Abstract

Studies were conducted on the etiology and management of coconut basal stem rot (*Ganoderma* wilt) in sandy soils of Karnataka. Fifty seven samples (diseased root bits, sporophores and diseased stem bits/bark) were collected during survey, from the treatment imposed experimental plots from various places. *Ganoderma* was isolated from 23 samples. For isolation of *Ganoderma*, sporophore and diseased root bits were found to be good sources. A pot culture experiment was laid out to prove the pathogenicity of *Ganoderma* isolates to the coconut seedlings through soil inoculation technique during the year 2007. Results revealed that, among the nine isolates tested, only two isolates ( $G_{13}$  and  $G_{14}$ ) were pathogenic.  $G_{13}$  and  $G_{14}$  isolates were isolated from root samples and are identified as *G. applanatum* based on colony morphology and mycelial characters. Among the eight treatments, the disease spread was less in palms that received Hexaconazole (1%) root feeding at quarterly intervals along with soil application of neem cake (@ 5 kg/palm/year) + *Trichoderma harzianum* @ 50 g/palm/half yearly) in all the gardens with an increase of 15.71 disease index over initial which accounted for 70.31% reduction over control. It was followed by the treatment Tridemorph (2%) root feeding + neemcake @ 5 kg / palm/year and treatment Hexaconazole (1%) root feeding + neem cake (@ 5 kg/palm/year, which accounted for 64.02 and 56.93 % reduction over control, respectively. In case of control, the spread of the disease was significantly high ( an increase of 52.92 over initial).

**Keywords:** Basal stem rot, coconut, etiology, management

## Introduction

Basal stem rot (BSR) or Thanjavur wilt of coconut, caused by *Ganoderma lucidum* is one of the most destructive diseases affecting coconut production in major coconut growing Southern states in India (Karunanithi *et al.*, 2005). The disease incidence was maximum (62.5%) in coconut palms raised in sandy soils and red soils while it was negligible (1.21%) and no incidence was observed in black soils and on paddy bunds or fish pond bunds, respectively (Srinivasalu *et al.*, 2003). Naik *et al.* (2000) reported that the disease severity ranged from 17.16 to 76.92 in Arsikere taluk of Hassan in Karnataka. Although several workers (Baskaran and Ramanathan, 1983; Baskaran *et al.*, 1994 and Srinivasalu *et al.*, 2001) reported different management practices against the disease, the results were inconsistent and not much work has been done relating to the integrated disease management aspects. Srinivasalu *et al.* (2004 a) stated that application of talc

based formulation of *Trichoderma* in combination with 5kg neem cake effectively checked the basal stem rot disease of coconut at ARS Ambajipet (AP). Karunanithi *et al.* (2005) stated that integration of cultural, chemical and biological methods would be useful to manage the BSR disease of coconut. Hence, the present study was conducted with an integration of bio agents, neem cake and chemicals to evolve effective management practices for the control of BSR disease (*Ganoderma* wilt) of coconut.

## Materials and Methods

Etiology and management of *Ganoderma* wilt disease of coconut:

### 1. Collection of *Ganoderma* isolates

Fifty seven samples were collected during the survey and from the treatment imposed experimental plots from various places. The collected specimens were surface sterilized and kept in sterilized bags along with

wet cotton under room temperature for about 8 – 10 days. After 8 – 10 days of incubation period, slight mycelial growth was observed and that was transferred into potato dextrose agar medium.

## 2. Pathogenicity of *Ganoderma* isolates to coconut seedlings

A pot culture experiment was laid out to prove pathogenicity of *Ganoderma* isolates on coconut seedlings through soil inoculation during the year 2007. Nine isolates ( $G_1, G_4, G_9, G_{13}, G_{14}, G_{16}, G_{30}, G_{32}$  (B) and  $G_{36}$ ) of *Ganoderma* were mass multiplied separately on sorghum grains in poly bags and were used for soil inoculation by mixing (200 g/pot) with the potting mixture at the time of planting. The treatments were replicated four times and the seedlings used are Tiptur tall and are of eight months age.

## 3. Management of Basal stem rot (BSR) disease of coconut

The integrated management trial was laid out in five locations in farmer's gardens and in ARS, Arsikere as one of the replications during April, 2000. The treatments were imposed from April, 2000 under irrigated as well as rain fed conditions. There were eight treatments and five palms in each treatment. Observations were recorded on the disease index and yield at quarterly intervals starting from April, 2000 to February, 2007.

The Disease Index (DI) was worked out by using the formula;  $DI=23.6+17.7h+3.6r-0.6l$ ; where h is the height upto which bleeding has been observed in the stem, l is the number of functional leaves in the crown and r is the score for reduction in leaf size (Bhaskaran and Karthikeyan, 1994).

### The treatments included are:

- T<sub>1</sub>. Tridemorph (2% - 100 ml.) root feeding (from April 2000 to Feb 2007 at quarterly interval).
- T<sub>2</sub>. T<sub>1</sub> + 5 kg neem cake (per palm/year from April 2000 to Feb 2007).
- T<sub>3</sub>. 5 kg Neem cake + *Trichoderma viride* (50 g/palm/half yearly from April 2000 to Feb 2007).
- T<sub>4</sub>. Hexaconazole (1%-100 ml.) root feeding (from April 2000 to Feb 2007 at quarterly interval).
- T<sub>5</sub>. T<sub>4</sub> + 5 kg neem cake (per palm/year from April 2000 to Feb 2007).
- T<sub>6</sub>. T<sub>5</sub> + *Trichoderma harzianum* (50 g/palm/half yearly from April 2000 to Feb 2007).

- T<sub>7</sub>. Soil application of *Pseudomonas fluorescence* (50g/palm/half yearly from April 2000 to Feb 2007)
- T<sub>8</sub>. Control.

## Results and Discussion

### 1. Collection of *Ganoderma* isolates

For isolation of *Ganoderma*, sporophore and diseased root bits were found to be good source. The percentage of isolates obtained from sporophore and diseased root bits was 50 (13 out of 26) and 40 (10 out of 25 samples), respectively. The *Ganoderma* was not isolated from diseased stem bits/bark. The isolated pathogens were identified as *Ganoderma lucidum* and *G. applanatum* based on colony morphology and mycelial characteristics.

Table 1. Collection and isolation of *Ganoderma* isolates

Sl. no.	Type of sample	Total no. of samples	<i>Ganoderma</i> isolated samples	% isolates obtained
1	Sporophore	26	13	50
2	Root samples	25	10	40
3	Diseased Stem Bits/bark	06	00	00
	Total	57	23	—

### 2. Pathogenicity of *Ganoderma* isolates to coconut seedlings

Results revealed that the seedlings inoculated with isolates  $G_{13}$  and  $G_{14}$  showed wilting symptoms. Isolate  $G_{13}$  caused complete wilting of two plants one at 60 days after inoculation and another at 75 days after inoculation. Similarly isolate  $G_{14}$  caused wilting of two plants at 75 and 90 DAI (Table 2). It clearly indicates that among the nine isolates tested, only two isolates ( $G_{13}$  and  $G_{14}$ ) were found to be pathogenic. They were isolated from root samples and identified as *G. applanatum* based on colony morphology and mycelial characteristics.

The causal organism was re-isolated from the two isolates  $G_{13}$  and  $G_{14}$  and was compared with the original culture. Thus, the pathogenicity of *Ganoderma* culture to coconut seedlings (Tiptur tall) was established through soil inoculation technique.

### 3. Management of Basal Stem Rot (BSR) disease of coconut

The results of integrated management trial revealed that the disease spread was minimum in palms that received Hexaconazole (1%) root feeding at quarterly intervals along with soil application of neem cake (@ 5 kg/palm/year) + *Trichoderma harzianum*

Table 2. Pathogenicity of *Ganoderma* isolates to coconut seedlings

Isolates	Isolated from	No. Plants wilted (DAI)							
		30	45	60	75	90	120	150	Total
1. G <sub>1</sub>	Sporophore	0	0	0	0	0	0	0	0
2. G <sub>4</sub>	Sporophore	0	0	0	0	0	0	0	0
3. G <sub>9</sub>	Sporophore	0	0	0	0	0	0	0	0
4. G <sub>13</sub>	Root samples	0	0	1	1	0	0	0	2
5. G <sub>14</sub>	Root samples	0	0	0	1	1	0	0	2
6. G <sub>16</sub>	Root samples	0	0	0	0	0	0	0	0
7. G <sub>30</sub>	Sporophore	0	0	0	0	0	0	0	0
8. G <sub>32</sub> (B)	Sporophore	0	0	0	0	0	0	0	0
9. G <sub>36</sub>	Sporophore	0	0	0	0	0	0	0	0
10. Control	—	0	0	0	0	0	0	0	0

DAI- Days after inoculation

(@ 50 g/palm/half yearly) in all the gardens with an increase of 15.71 disease index over initial which accounted for 70.31% reduction over control. It was followed by Tridemorph (2%) root feeding + neemcake @ 5 kg / palm/year and Hexaconazole (1%) root feeding + neem cake @ 5 kg/palm/year, which accounted for 64.02 and 56.93 % reduction over control, respectively (Table 3). In the case of control, the spread of the disease was significantly high (an increase of 52.92 over initial).

Results also revealed that the combined treatments gave significantly higher nut yield (Table 3) during 2006-07 compared to other treatments and control. The severity of the disease substantially increased in rainfed coconut gardens compared to irrigated coconut gardens in certain treatments. Nevertheless, the progression of the disease in control treatments was fastest and a few palms died, especially under rainfed conditions. In all the gardens, the disease intensity was less in treated palms compared

to control. However, there was an increase in disease index values both in the treated and untreated palms over the initial values.

An IDM package with a combination of *T. viride* (50g) and neem cake @5 kg/palm/year was found to be highly effective in the management of BSR disease of coconut Srinivasalu *et al.* (2004). Bio control agents like *Trichoderma harzianum* and *T. viride* were reported to be antagonistic to *Ganoderma lucidum* (Gunasekaran *et al.*, 1986 and Baskaran, 1990a). Srinivasalu *et al.* (2004 b) reported that native bio control agents *viz* *T. viride*, *T. harzianum*, *T. hamatum* were found to be inhibitory to *G. applanatum* and *G. lucidum*. Tridemorph (0.1%) and Hexaconazole (0.1%) were found to completely inhibit both *G. applanatum* and *G. lucidum* under *in vitro* condition. Baskaran *et al.* (1990b) stated that incorporation of organic manures, especially neem cake into the soil and irrigation during summer reduced

Table 3. Effect of integrated disease management practices on the management of basal stem rot of coconut and nut yield

Treatments	Disease Index*				Yield/palm* 2006-07 (Mean)
	Initial April 2000	Upto Feb.2007	Increase over initial	% reduction over control	
T <sub>1</sub> -Tridemorph(2%) root feeding	20.34	51.21	30.87	42.00	76.27
T <sub>2</sub> -T <sub>1</sub> + Neem cake @ 5 kg/palm/year	21.67	40.71	19.04	64.02	81.13
T <sub>3</sub> -Neem cake @ 5 kg/palm/year + <i>Trichoderma viride</i> (@ 50 g/palm/half yearly)	20.41	50.22	29.81	44.00	81.03
T <sub>4</sub> -Hexaconazole (1%) root feeding	21.85	48.68	26.83	49.00	78.20
T <sub>5</sub> -T <sub>4</sub> + Neemcake @ 5 kg/palm/year	21.77	44.56	22.79	56.93	85.90
T <sub>6</sub> -T <sub>5</sub> + <i>Trichoderma harzianum</i> (@ 50 g/palm/half yearly)	21.60	36.98	15.71	70.31	90.73
T <sub>7</sub> - <i>Pseudomonas fluorescens</i> (@ 50 g/palm/half yearly)	22.04	55.07	33.03	38.00	76.60
T <sub>8</sub> -Control	21.10	74.02	52.92	—	59.83
SE(m) ±	0.82	3.18	—	—	2.40
C.D (P = 0.05)	NS	6.46	—	—	4.88
C.V (%)	9.39	10.98	—	—	5.29

\*Mean of 6 replications with 5 palms/replication

disease severity. Root treatment of coconut palm infected by *Ganoderma lucidum* with Tridemorph (2ml/100ml water) at quarterly intervals for one year combined with annual application of 5 kg neem cake/palm reduced disease incidence and increased yields by 132 % (Baskaran, 1993). Application of neem cake @ 10 kg/palm/year increased the total population of fungi in rhizosphere and inhibited the growth of *G. lucidum* (Gunasakaran *et al.*, 1986). Srinivasalu *et al.* (2001) stated that 50g *T. viride* + neem cake (1kg) per palm per year controlled the linear spread of *Ganoderma* to the extent (22 cm) against 77.6 cm in un treated palms. Jayarajan *et al.* (1987) stated that neem cake is effective in reducing *Ganoderma* wilt of coconut.

The lowest disease index was recorded in treatment with tridemorph root feeding (2%) + soil drenching (0.3%), followed by hexaconazole root feeding (1%) + soil drenching (Naik, 2001).

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#### References

- Bhaskaran, R and Ramanathan, T. 1983. Role of fertilizers and organic manures in Thanjavur wilt of coconut. *Indian Coconut J.* 14(3): 1-5.
- Bhaskaran, R. 1990a. Biological control of Thanjavur wilt disease of coconut. pp.7-8. In: *National symposium on Bio control of Root disease*. Annamalai University, Annamalai Nagar (Abstr.).
- Bhaskaran, R., Suriachandraselvan, M. and Ramachandran, T.K. 1990b. *Ganoderma* wilt disease of coconut-a threat to coconut cultivation in India. *Planter* 66(774): 467-471.
- Bhaskaran, R. 1993. Integrated management of basal stem rot disease of coconut *Indian Coconut J.* 24(4): 5-8.
- Bhaskaran, R., Rethinam, P., and Nambiar, K.K.N. 1994. *Ganoderma* wilt disease of coconut. pp. 898-920. In: *Advances in Horticulture*. Vol.10 - Plantation and Spice Crops. Part-2.
- Bhaskaran, R. and Karthikeyan, A. 1994. A method for assessing severity of basal stem rot disease of coconut. *J. Plantn. Crops* 22(2): 93-96.
- Gunasekaran, M., Romadass, N., Ramaiah, M., Bhaskaran, R and Ramanathan, T. 1986. Role of neem cake in the control of Thanjavur wilt of Coconut. *Indian Coconut J.* 17(1): 7-12.
- Jayarajan R., Sabitha, D., Baskaran. R., Jayarajan S. 1987 Effect of neem (*Azadirachta indica*) and other plant products in the management of plant diseases in India. Natural pesticides from the neem tree *Azadirachta indica*, A Juss and other tropical plants.
- Karunanithi, K., Sarala, L., Manickam, G, Rajarthinam, S. and Khan, H.H. 2005. Management of basal sem rot of coconut. *Indian Coconut Journal* 35(9): 10-11.
- Naik, R.G, Palanimuthu, V., Hanumanthappa, M. and Indires, K.M. 2000. Prevalence and intensity of basal stem rot disease of coconut in Arsikere taluk of Karnataka. *Indian Coconut J.* 31(1): 8-10.
- Naik, R.G 2001. Chemical control of basal stem rot of coconut (*Cocos nucifera* (L.)) *Agricultural Science Digest* 21(4): 247-249.
- Srinivasalu, B., Aruna, K and D.V.R. Rao, 2001a. Bio control of *Ganoderma* wilt of coconut palm. *National Seminar on changing scenario in production system of Horticultural Crops. South Indian Hort.* 49: 240-241.
- Srinivasalu, B., Aruna, K., Sabitha Doraiswamy and D.V.R. Rao, 2001b. Occurrence and Bio control of *Ganoderma* wilt disease of coconut in Coastal Agro-Ecosystem of Andra Pradesh. *J. Indian Sco. Coastal Agric. Res.* 19(1&2): 191-195.
- Srinivasalu, B., Aruna, K., D.V.R. Rao and Hameed Khan, H. 2003. Epidemiology of Basal Stem Rot (*Ganoderma* wilt) disease of coconut in Andhra Pradesh. *Indian J. Plant Protection* 31(1): 48-50.
- Srinivasalu, B., Aruna, K., Vijay Krishna Kumar, K. and Rao, D.V.R. 2004 a. Bio control potential of *Trichoderma viride* against basal stem rot disease of coconut. *J. Plantn. Crops* 32(1): 28-31.
- Srinivasalu, B., Vijay Krishna Kumar, K., Aruna, K, and Rao, D.V.R. 2004 b. Bio control of major pathogens of coconut. *J. Plantn. Crops* 32(Suppl.): 309-313.