

Integrated Disease Management of *Ganoderma* Wilt of Coconut in Dry Tracts of Southern Karnataka

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ABSTRACT

Integrated disease management studies on *Ganoderma* wilt of coconut were carried out in dry tracts of southern Karnataka during 2014-2016. Pooled results revealed that, among the different treatment combinations, the disease index was less in palms that received Tebuconazole 25.9 per cent EC root feeding @1.5 ml in 100 ml water / palm at quarterly interval + Soil application of 5 kg Neemcake enriched with *Trichoderma viride* / palm / half yearly + *Pseudomonas fluorescens* (talc formulated) @ 50 g/palm/ half yearly + Soil drenching with 1 per cent BM @ 20 L / Palm half yearly with an increase of 10.57 disease index over pre-treatment which accounted for 76.41 per cent reduction over control and recorded maximum nut yield (51.55 nuts / palm / year) as against 22.66 in control.

Ganoderma wilt or Basal Stem Rot (BSR) or Thanavur wilt of coconut, caused by *Ganoderma lucidum* is one of the most destructive diseases affecting coconut production in southern states of India (Karunanithi *et al.*, 2005). The disease incidence was maximum (62.5%) in coconut palms cultivated in sandy soils and red soils while it was negligible (1.21%) and nil in black soils, paddy bunds or fish pond bunds (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 (Basakaran *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) recommended 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 bioagents, neem cake and chemicals to evolve effective management practices for the control of BSR disease (*Ganoderma* wilt) of coconut.

The integrated disease management trial was laid out in two locations in farmers gardens at Mathihally

and Chickbidire, Tiptur taluk. Tumkur district during June, 2014 with Table I.

The treatments were imposed in June, 2014 under protective irrigated conditions and replicated three times. The treatments were repeated once in four/six months wherever necessary. Observations were recorded on the disease index and nut yield at quarterly intervals starting from June, 2014 to April 2016.

The Disease Index (DI) was worked out by using the formula; $DI = 23.6 + 17.7h + 3.6r - 0.61$; 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 results of integrated disease management trial at Mathihally (Location I) revealed that the disease spread was minimum in palms that received Tebuconazole 25.9 per cent EC root feeding @1.5ml in 100ml water / palm at quarterly interval + Soil application of 5kg Neemcake enriched with *T. viride* / palm / half yearly + *P. fluorescens* (talc formulated) @ 50 g/palm/ half yearly + Soil drenching with 1 per cent BM @ 20 liters / Palm half yearly (T_9) with least increase in disease index of 10.55 over initial amounting to 75.23 per cent reduction over control. This was followed by Tebuconazole 25.9 per cent EC root feeding @1.5ml in 100ml water / palm at quarterly interval + Soil application of 5kg Neemcake enriched

TABLE I
Treatment details

Treatments	Particulars
T ₁	Root feeding (RF) with Tebuconazole 25.9 % EC @1.5ml in 100ml water / palm at quarterly interval
T ₂	RF with Thifluzamide 24% SC @1.5ml in 100ml water / palm at quarterly interval
T ₃	T ₁ + Soil application (SA) of 5kg Neemcake enriched with <i>T. viride</i> / palm/ half yearly
T ₄	T ₁ + SA of <i>Pseudomonas fluorescens</i> (talc formulated) @ 50 g / palm / half yearly + Neemcake @ 5 Kg / palm/year
T ₅	T ₁ + SA of 5kg Neemcake enriched with <i>T. viride</i> / palm / half yearly + <i>P. fluorescens</i> (talc formulated) @ 50 g / palm / half yearly
T ₆	T ₂ + SA of 5kg Neemcake enriched with <i>T. viride</i> / palm / half yearly
T ₇	T ₂ + SA of <i>P. fluorescens</i> (talc formulated) @ 50 g / palm / half yearly + Neemcake @ 5 Kg / palm / year
T ₈	T ₂ + SA 5kg Neemcake enriched with <i>T. viride</i> / palm / half yearly + <i>P. fluorescens</i> (talc formulated) @ 50 g / palm / half yearly
T ₉	T ₅ + Soil drenching with 1% BM @ 20 liters / Palm half yearly
T ₁₀	T ₈ + Soil drenching with 1% BM @ 20 liters / Palm half yearly
T ₁₁	Hexaconazole 5% EC root feeding @ 3 ml in 100ml water/palm at quarterly intervals+ soil application of 50g talc based formulation of <i>T. viride</i> along with 5 kg Neem cake and 10 kg FYM / palm once in 6 months (POP)
T ₁₂	Absolute control

with *T. viride* / palm / half yearly + *P. fluorescens* (talc formulated) @ 50 g / palm / half yearly which accounted 71.10 per cent reduction over control with an increase of 12.31 disease index over initial (T₅) and Root feeding with Thifluzamide 24 per cent SC @1.5ml in 100ml water / palm at quarterly interval + soil application of 5kg Neemcake enriched with *T. viride* / palm / half yearly + *P. fluorescens* (talc formulated) @ 50 g / palm / half yearly which accounted 69.53 per cent reduction over control with an increase of 12.98 disease index over initial (T₈). In case of control, the spread of the disease was significantly high showing 42.60 increase over initial (Table II). Similar results were also observed at Chickbidire (Location II).

Nut yield was maximum in T₉ (46.05 nuts/palm/year) at Mathihally (Location I) followed by T₁₀ and T₅ which recorded 45.67 and 45.47 nuts/palm/year respectively as against 23.99 in untreated palms

(Table II). Similar results were also observed at Chickbidire (Table III).

Results also revealed that the combined treatments gave significantly higher nut yield (Table II, and III) compared to individual treatments and control. The severity of the disease substantially increased in all the treatments but the rate of increase varied significantly from treatment to treatment. Nevertheless, the progression of the disease in control treatments was fastest in both the locations. In both 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.

Combination of *T. viride* (50g) and neem cake @ 5kg / palm / year was found to be highly effective in the management of BSR disease of coconut

TABLE II

Effect of integrated disease management practices on the management of Ganoderma wilt of coconut and nut yield (Location I)

Treatments	Disease Index*				Nut Yield palm / Year **
	Before treatment (June 2014)	After treatment (April 2016)	Increase over initial	% reduction over control	
T ₁	15.08	34.23	19.15	55.45	37.96
T ₂	12.77	31.10	18.33	56.97	36.98
T ₃	15.23	30.26	15.03	64.72	39.66
T ₄	14.07	31.57	17.50	58.92	38.41
T ₅	12.48	24.79	12.31	71.10	45.47
T ₆	14.95	29.80	14.82	65.22	42.16
T ₇	17.80	34.53	16.73	60.72	39.41
T ₈	14.84	26.82	12.98	69.53	44.93
T ₉	15.07	25.62	10.55	75.23	46.05
T ₁₀	12.94	25.75	12.81	69.92	45.67
T ₁₁	14.53	28.99	14.46	66.06	43.33
T ₁₂	14.94	57.54	42.60	—	23.99
SEm ±	3.67	12.47	—	—	4.655
C.D (P=0.05)	NS	5.98	—	—	3.65
CV (%)	13.32	11.13	—	—	5.34

*Mean of three replications

** Mean nut yield/palm/year

TABLE III

Effect of integrated disease management practices on the management of Ganoderma wilt of coconut and nut yield (Location II)

Treatments	Disease Index*				Nut Yield palm / Year **
	Before treatment (June 2014)	After treatment (April 2016)	Increase over initial	% reduction over control	
T ₁	12.53	31.68	19.15	59.24	31.84
T ₂	16.14	35.28	19.14	59.26	32.84
T ₃	14.12	30.28	16.16	65.60	35.34
T ₄	10.69	26.80	16.11	65.70	39.50
T ₅	13.52	25.34	11.82	74.84	56.99
T ₆	12.54	25.74	13.20	71.90	40.11
T ₇	12.57	29.50	16.93	63.96	46.78
T ₈	12.39	25.24	11.88	72.64	53.00
T ₉	13.54	24.13	10.59	77.58	57.05
T ₁₀	12.74	26.04	13.30	71.69	51.78
T ₁₁	15.11	28.53	13.42	71.43	53.34
T ₁₂	12.93	59.91	46.98	—	21.34
SEm ±	3.18	11.01	—	—	7.87
C.D (P=0.05)	NS	5.62	—	—	4.75
CV (%)	13.40	10.82	—	—	6.47

*Mean of three replications

** Mean nut yield/palm/year

(Srinivasalu *et al.*, 2004a). 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. Bhaskaran *et al.*, (1990) stated that incorporation of organic manures, especially neem cake into the soil and irrigation during summer reduced 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 per cent (Bhaskaran , 1993). Application of Neem cake @ 10kg / palm / year increased the total

population of fungi in rhizosphere and inhibited the growth of *G. lucidum* (Gunasekaran *et al.*, 1986). Srinivasalu *et al.* (2001) stated that 50gm *T. viride* + Neem cake (1kg) / palm / year controlled the linear spread of *Ganoderma* to the extent (22cm) 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). Karthikeyan *et al.*, 2006, stated that, the mixture of two antagonists (*P. fluorescens* + *T. viride*) suppressed *Ganoderma* disease development in coconut. From the present study too it can be concluded that integrated disease management practices with amalgamation of fungicides, bio-control agents along with neem cake is effective for the management of *Ganoderma* wilt of coconut in dry tracts of southern Karnataka.

TABLE IV

Effect of integrated disease management practices on the management of Ganoderma wilt of coconut and nut yield (Location I & II)

Treatments	Disease Index*				Nut Yield palm/Year**
	Before treatment (June 2014)	After treatment (April 2016)	Increase over initial	% reduction over control	
T ₁	13.80	32.95	19.15	57.35	34.90
T ₂	14.46	33.19	18.74	58.12	34.91
T ₃	14.67	30.27	15.59	65.16	37.50
T ₄	12.38	29.18	16.80	62.31	38.95
T ₅	13.00	25.06	12.06	72.97	51.23
T ₆	13.74	27.77	14.01	68.56	41.14
T ₇	15.18	32.02	16.83	62.34	43.09
T ₈	14.12	26.03	11.93	71.08	48.96
T ₉	14.30	24.87	10.57	76.41	51.55
T ₁₀	12.84	25.89	13.06	70.80	48.73
T ₁₁	14.82	28.76	13.94	68.75	48.34
T ₁₂	13.94	58.73	44.79	57.35	22.66

* Mean of two locations

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