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Fungicidal Management of Basal Stem rot -A Soil Borne Diseases in Coconut

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ABSTRACT: Coconut palm is affected by a large number of diseases, among which basal stem rot (BSR) disease caused by *Ganoderma lucidum* and *Ganoderma applanatum* are the most destructive and a major limiting factor in coconut production. The research was conducted during the year 2020-21 and 2022-2023 at Dr. YSRHU-Horticultural Research Station, Ambajipeta, Dr. B.R. Ambedkar Konaseema District, Andhra Pradesh under the research project ICAR-AICRP on Palms. Results indicated that among the chemical fungicides tested under *in vitro*, combi fungicide formulations *i.e* Hexaconazole 5% + Validamycin 2.5% SC and Azoxystrobin 11% + Tebuconazole 18.3% SC (Custodia), Famaxadone 16.6% + Cymaxanil 22.1% SC, Carbendazim 12% + Mancozeb 63% WP and Hexaconazole 4 % + Zineb 68% were found most effective with an inhibition range ~ 97% to 99 % and on par with single fungicide formulations *i.e* Hexaconazole 5% EC, Thifluzamide 24% SC and Mancozeb 75% WP at 100ppm, 250ppm and 500 ppm concentrations tested. When the selected fungicides further tested at field level, it was noticed that T6-Root feeding of Hexaconazole 5% + Validamycin 2.5% SC @4 ml in 100 ml water + soil drenching @2ml/litre with 15 litre/palm at quarterly interval recorded 40.75.00 per cent reduction over initial at 27 months after treatment followed by T7-Root feeding of Hexaconazole 5% EC alone recorded 36.20% reduction and thirdly T4- Root feeding of Hexaconazole 5% + Validamycin-2.5% SC @4 ml in 100 ml water recorded 32.08% reduction over initial.

Keywords: Basal Stem Rot, Coconut, *Ganoderma*, Fungicides, Root Feeding, Soil Drenching.

INTRODUCTION

Coconut palm (*Cocos nucifera*, L.) is an important plantation crop of India and often described as 'Kalpavriksha' because of the multifarious uses of every part of it in the commercial sector. Coconut palms are successfully grown in the tropical countries of the world and are hence referred to as "King of the tropical palms." The South Pacific and South Africa are often cited as possible center of origin. Coconut provides food, drink, shelter and industrial raw materials. Coconut is grown in almost 94 countries in the world of which 90 per cent of the production comes from Asian and Pacific countries.

Coconut plays vital role in rural horticulture economy with a total production of 13411 trillion tonnes in India and 1112 trillion tonnes as share of 8.27% and ranks 4th in Andhra Pradesh with an area and production (1.15 lakh ha; 1378 million nuts) after Kerala, Karnataka and Tamil Nadu with a productivity of 11957 nuts/ ha 2021-22). In erstwhile Andhra Pradesh, East Godavari (50,490 ha), West Godavari (21, 818 ha), Srikakulam (14,753 ha) and Visakhapatnam (7300 ha) districts occupy major area in forefront in coconut cultivation [NHB 2021-22].

Coconut is infected by many deadly and control debilitating diseases in India *viz.*, bud rot (Phytophthora palmivora), basal stem rot (BSR) treatment (*Ganoderma* spp.), stem bleeding (*Thielaviopsis paradoxa*), grey leaf spot (*Pestalotiopsis palmarum*), leaf blight (*Lasiodiplodia theobromae*) and root (wilt) (*Phytoplasma*). Among them, basal stem rot disease caused by *G. applanatum* and *G. lucidum* is one of the lethal diseases, which is distributed and accounting to severe yield loss in all coconut growing tracts of southern parts of India. The disease is also known as *Ganoderma* wilt (Andhra Pradesh) or Tanjavur wilt (Tamil Nadu) or Bole rot or Anabe roga (Karnataka) in different areas (Naik, 2001). Severe incidence as high as 31 per

cent in some of the coconut gardens in Thanjavur district has been reported (Bhaskaran and Ramanathan 1984). Exudation of viscous reddish-brow n coloured fluid from the stem (referred to as 'bleeding') is the first sign of the disease which progresses upwards. Drooping drying and falling of leaves, extensive root rot and death of the palms are the characteristic symptoms of the basal stem rot. Sporophores of *Ganoderma* spp. form at the base of the trunk before wilting or immediately after the death of the palm (Bhaskaran *et al.*, 1989). In recent years, the disease has become a big menace, especially in poorly managed coconut gardens.

Association of *Ganoderma lucidum* with BSR disease of coconut was reported by Vijayan and Natarajan (1972) and Bhaskaran *et al.* (1990). Pathogenicity of *Ganoderma* spp. isolated from *Ganoderma* wilt infected coconut palm was proved by many researchers. Both *G. applanatum* and *G. lucidum* were isolated from the diseased root bits of coconut. However, colonization of *G. lucidum* was very fast when compared to *G. applanatum*. Root rotting up to 21% was observed in palms inoculated with *G. lucidum* and only colonization up to 8 to 10 cm on either side of inoculation point was observed with *G. applanatum* (Bhaskaran *et al.*, 1991, Srinivasulu *et al.*, 2005). Naik *et al.* (2008) reported that disease symptoms developed in coconut seedlings after 9 to 11 months under artificial inoculation conditions. Occurrence of both the species as the causal organism of basal stem rot of coconut was reported and there was wider variation morphologically and genetically among the isolates of *Ganoderma* collected from various districts of the states (Anonymous 2014).

Among the several chemicals tried for the control of the disease, Bordeaux mixture, Heptachlor dust and Copper oxy chloride along with BHC controlled the disease to certain extent if applied in earlier stages of infection (Vijayan and Natarajan 1972). Bordeaux mixture (1%), Aureofungin-sol (0.2%) chemicals alone or in combination were reported as effective chemicals by several workers (Bhaskaran and Ramanathan 1982, Bhaskaran *et al.*, 1984). Drenching with 10 litre of Benomyl (0.1%) was reported by Kolandaisamy and Arjunan (1977). In vitro inhibitory effect of Tridemorph (500 ppm) was reported by Anbalagan and Shanmugam (1984). Sindha Mathur and Balasubramaniam (1987) reported that soil drenching with 0.1% IBP, carboxin, tridemorph or 0.05% carbendazim in combination with 5 kg neem cake per palm reduced disease intensity. Field trials at Palghat (Kerala), Veppankulam (Tamil Nadu) and Andhra Pradesh reported that tridemorph and Aureofungin-sol in combination with neem cake reduced disease intensity. Other studies reported that Aureofungin-sol (2 g) + 1% Bordeaux mixture (40 litre) + neem cake (5 kg) checked further spread of the disease. The lowest BSR index was obtained by the application of Tridemorph root feeding (2%) + soil drenching (0.3%) followed by Hexaconazole root feeding (l%) + soil drenching (0.2%), soil drenching with Tridemorph (0.3%) and Hexaconazole (0.2%) compared to root feeding alone (Naik 2001). Fungicides *viz*., Bordeaux mixture, Triademifon, Tridemorph, Bitertenol, Copper Oxy Chloride, Hexaconazole were found to inhibit *G. applanatum* and *G. lucidum* under in vitro conditions and were also found inhibitory to *Trichoderma viride* (Srinivasulu *et al*., 2002). According to Thirumalaiswamy *et al*. (1992), treatments with fungicides to be taken up by roots are effective only in the early stages of the disease.

As the disease is a constant threat to coconut farmers of southern states of India, various authors attempted integrated disease management approaches to control the disease. Soil drenching with 1% Bordeaux mixture (40 l/palm) and application of neem cake (5 kg/palm) in basins followed by root feeding with Tridemorph (6 ml/palm) was found more effective in reducing the disease index of BSR in Andhra Pradesh (Srinivasulu *et al*., 2005). Residue analysis for the rate of accumulation of Tridemorph @ 2, 4, 6 ml/ palm in coconut water and copra after root feeding showed that the residues were at lower than tolerance limits. Karthikeyan *et al.* (2006) found that the combination of basin method of irrigation, soil application of neem cake (5 kg/palm), soil application of talc formulations of *T. viride* and P. fluorescens (200 g each/palm) and root feeding of tridemorph 2% (100 ml palm at quarterly intervals) gave effective control of vertical spread of pathogen with a reduction of 92.1% over control and horizontal spread with a reduction of 45.5% over control.

Rajappan and Vaithilingam (2009) reported integrated disease management system (IMS) consisting of cultural (basin irrigation, application of the recommended fertilizer rates, application of 50 kg farmyard manure/plant, basin management with 50 g sunnhemp and in situ incorporation, and intercropping with banana in 2 rows within 2 rows of coconut), biological (application of *Trichoderma viride* and *Pseudomonas fluorescens* at 200 g plant each) and chemical (application of tridemorph or hexaconazole at 200 ml/100 ml of water at quarterly intervals) control systems were effective against basal stem rot disease.

Palanna *et al.* (2009) found that the disease spread was less (70.31% reduction over control) with root feeding of Hexaconazole (1%) at quarterly intervals along with soil application of 5 kg neem cake and 50 g of Trichoderma harzianum per palm at half yearly interval. Root feeding of tridemorph (2%) along with application of 5 kg neem cake/ palm/year and root feeding of hexaconazole (1%) combined with application of 5 kg neem cake/palm/year also

reported less disease spread (64.02 and 56.93% reduction over control, respectively). The present investigation was taken up with an intention to evaluate recent fungicides and develop new management technology for the management of basal stem rot disease in coconut.

MATERIALS AND METHODS

A. Isolation of basal stem rot pathogen

The Coconut palm depicting characteristic symptoms of basal stem rot disease was selected and infected roots/ sporophore collected from infected palms were washed thoroughly with sterile water and cut into small bits/pieces and were surface sterilized in 1 per cent sodium hypochlorite solution for 30 seconds and rinsed with sterile distilled water thrice serially to remove the traces of sodium hypochlorite. After surface sterilization, diseased specimens were kept in sterilized bags along with wet cotton under room temperature for about 8 to10 days. After 8 to 10 days of incubation period ,slight mycelial growth was observed and that was transferred into potato dextrose agar (PDA) medium. The inoculated plates were incubated at room temperature (28 °C ± 2 °C) for 3-5 days to facilitate growth of the fungus. Later, the bit of fungal growth was transferred to PDA slants. The pure culture of the fungus was obtained by following hyphal tip culture technique under aseptic conditions (Plate 1&2).

B. In vitro evaluation of fungicides

To manage the basal stem rot disease in coconut, systemic, contact & combi fungicides namely Ibrufenophos 48% EC (Kitazin), Famaxadone 16.6% + Cymaxanil 22.1% SC (Equation Pro), Hexaconazole 4% + Carbendazim 16% SC (Sofia), Azoxystrobin 11% + Tebuconazole 18.3%SC, Cyazafamid 34.5% SC (Ranman), Thifluzamide 24% SC (Pulsor), Carbendazim 12% + Mancozeb 63% WP, Hexaconazole 5% SC + Validamycin 25% SC, Hexaconazole 4 % + Zineb 68% WP (Avatar), Mancozeb 75% WP, and standard check Hexaconazole 5% SC were selected to evaluate at their recommended concentration using food poison technique (Table 1). The radial growth of the test fungal colony recorded on 6th day when maximum growth was observed in untreated control plates. The percent inhibition of the mycelia growth over control was calculated using formula given by Vincent (1942).

$$I = \frac{C - T}{C} \times 100$$

I = % inhibition of mycelia growth
C= radial growth of fungus in control
T = radial growth of fungus in treatment

Table 1: List of fungicides tested against *Ganoderma* spp.

Tr. No.	Fungicide	Contact/systemic/ combi fungicide	Trade name	Manufacturer
T1	Ibrufenophos 48% EC	Systemic fungicide	Kitazin	P I Industries limited
T2	Famaxadone16.6%+Cymaxanil 22.1% SC	Combi - Systemic and contact fungicide	Equation Pro	Dupont
T3	Hexaconazole 4% + Carbendazim 16% SC	Combi - Systemic fungicide	Sofia	Insecticides india limited
T4	Hexaconazole 5% EC	Systemic fungicide	Contaf	Tata Rallis India Ltd
T5	Azoxystrobin 11% + Tebuconazole 18.3%SC	Combi - Systemic fungicide	Custodia	ADAMA Ltd.
T6	Cyazafamid34.5%SC	Systemic fungicide	Ranman	United Phosphorus Limited
T7	Thifluzamide 24%SC	Systemic fungicide	Pulsor	Insecticides india limited
T8	Carbendazim 12% + Mancozeb 63% WP	Combi - Systemic and contact fungicide	SAAF	United Phosphorus Limited
T9	Hexaconazole 5% SC + Validamycin 25% sc	Combi - Systemic fungicide	Validex	Agri science company
T10	Hexaconazole 4 % + Zineb 68% WP	Systemic fungicide	Avatar	Indofil Industries Ltd.
T11	Mancozeb 75% WP	Contac fungicide	Indofil M-45	Indofil Industries Ltd.
T12	Control-Untreated	-	-	-

Statistical analysis was followed as per the OP STAT with Number of treatments: 11, Number of replications: 3 and Design : CRD

Evaluations of identified systemic fungicides against stem bleeding disease under field conditions

Based on the *in vitro* studies, the effective combi systemic fungicides *viz.*, Azoxystrobin 11% + Tebuconazole 18.30% SC and Hexaconazole 5% + Validamycin 2.5% SC were selected for field evaluation against basal stem rot disease of coconut at farmer's coconut garden at Pedapatnamlanka village of Dr. B.R. Ambedkar Konaseema district. Pre data of basal stem disease was recorded before treatment imposition. The positive control was maintained with root feeding of Hexaconazole 5% SC @ 4 ml in 100 ml of water/Palm to compare efficacy of the test

fungicides. The treatments have been imposed at quarterly intervals.

T1. Root feeding of Azoxystrobin 11% + Tebuconazole-18.3% SC @ 4 ml in 100 ml water

T2. Soil drenching of Azoxystrobin 11% + Tebuconazole-18.3% SC @ 2ml/litre - 15 litre/palm

T3. Root feeding of Azoxystrobin 11% + Tebuconazole-18.3% SC @ 4 ml in 100 ml water + Soil drenching @ 2ml/litre -15 litre/palm

T4. Root feeding of Hexaconazole 5% + Validamycin-2.5% SC @4 ml in 100 ml water

T5. soil drenching Hexaconazole 5% + Validamycin-2.5% SC @2ml/litre - 15 litre/ palm

T6. Root feeding of Hexaconazole 5% + Validamycin-2.5% SC @4 ml in 100 ml water + soil drenching @2ml/litre -15 litre/palm

T7. Positive check - Root feeding of Hexaconazole @ 3ml +100 ml water

T8. Control

Statistical analysis was followed OP STAT with Number of treatments: 8, Number of replications: 4 Design: RBD

Disease index: All the experimental palms in this trial were indexed for disease using formula Disease index= 23.6+17.4H+36.6R-0.6L where H-height of bleeding patch, R- reduction in leaf size (0-4 scale), L-Number of functional leaves. The disease index at the beginning and at quarterly interval was recorded in individual replication and the average was calculated (Bhaskaran *et al.*, 1989).

Statistical analysis. The data were statistically analyzed using the OPSTAT 1996 developed by O. P. Sheoran, "Hisar. Statistical Package for Agricultural Scientists (OPSTAT)", CCS HAU.

RESULTS AND DISCUSSION

In vitro evaluation of contact, systemic and combi fungicides *viz*., Ibrufenophos 48% EC (Kitazin), Famaxadone 16.6% + Cymaxanil 22.1% SC (Equation Pro) Hexaconazole 4% + Carbendazim 16% SC (Sofia), Hexaconazole 5% EC, Azoxystrobin 11% + Tebuconazole 18.3%SC, Cyazafamid 34.5%SC (Ranman), Thifluzamide 24%SC (Pulsor), Carbendazim 12% + Mancozeb 63% WP, Hexaconazole 5% SC + Validamycin 25% sc, Hexaconazole 4 % + Zineb 68% (Avatar) and Mancozeb 75% WP were tested against *Ganoderma* spp at 100 ppm, 250ppm, 500 ppm (Table 2, Plate 3 & Plate 4).

Among the chemical fungicides tested, T2 [Famaxadone16.6% + Cymaxanil 22.1% SC], T4 [Hexaconazole 5% EC], T5- Azoxystrobin 11% + Tebuconazole 18.3% SC (Custodia), T7- Thifluzamide 24%SC (Pulsor), T8 [Carbendazim 12% + Mancozeb 63% WP] & T10 [Hexaconazole 4 % + Zineb 68%] are found most effective and on par with 97% to 99 % inhibition at all the concentrations tested followed by treatment T5 [Azoxystrobin 11% + Tebuconazole 18.3%SC], T7 [Thifluzamide 24%S], T9 [Hexaconazole 5% + Validamycin 2.5% SC] and T11 [Mancozeb 75% WP] which were performed on par with 76.29 to 98.89 % inhibition. The treatment T1 [Ibrufenophos 48% EC] showed 66.66, 75.93% and 86% respectively at 100, 250 and 500 ppm respectively. Lastly the treatment T6 [Cyazafamid 34.5%SC] has showed 0.00%, 16.30% and 76.67% respectively at 100ppm, 250ppm and 500 ppm concentrations tested.

Table 2: *In vitro* evaluation of fungicides against basal stem rot disease causing pathogen *Ganoderma* spp in coconut.

Treatments	Mycelial Growth (mm) of ***T. paradoxa***			Percent inhibition over control		
	100 ppm	250 ppm	500 ppm	100 ppm	250 ppm	500 ppm
T1: Ibrufenophos 48% EC (Kitazin)	30.00 (33.16)	21.67 (27.71)	12.33 (20.50)	66.66	75.93	86.30
T2: Famaxadone16.6%+Cymaxanil 22.1% SC (Equation Pro)	1.33 (5.24)	1.00 (3.32)	0.67 (2.71)	98.51	98.89	99.26
T3: Hexaconazole 4% + Carbendazim 16% SC (Sofia)	67.67 (55.42)	54.33 (47.50)	29.00 (32.55)	24.81	39.63	67.78
T14: Hexaconazole 5% EC (Contaf)	1.33 (3.85)	0.67 (2.71)	0.67 (2.71)	98.51	99.26	99.26
T5: Azoxystrobin 11% + Tebuconazole 18.3% SC (Custodia)	1.00 (3.32)	1.33 (3.85)	1.00 (3.32)	98.88	98.52	98.89
T6: Cyazafamid 34.5% SC (Ranman)	90.00 (71.57)	75.33 (60.30)	21.00 (27.26)	0.00	16.30	76.67
T7: Thifluzamide 24%SC (Pulsor)	1.67 (2.71)	1.33 (3.85)	1.00 (3.32)	98.25	98.52	98.89
T8: Carbendazim 12% + Mancozeb 63% WP	2.00 (7.95)	2.33 (7.02)	0.67 (2.71)	97.77	97.41	99.26
T9: Hexaconazole 5% + Validamycin 2.5% sc	1.00 (3.32)	1.00 (3.32)	1.00 (3.32)	98.88	98.89	98.89
T10: Hexaconazole 4 % + Zineb 68% (Avatar)	1.00 (3.32)	1.67 (6.03)	0.67 (2.71)	98.88	98.15	99.26
T11: Mancozeb 75% WP Indofil M-45	21.33 (27.47)	1.33 (3.85)	1.00 (3.32)	76.29	98.52	98.89
T12: Control	90.00 (71.57)	90.00 (71.57)	90.00 (71.57)	0.00	0.00	0.00

SEm+	2.51	2.96	2.54			
CD 1%	9.93	11.72	10.04			

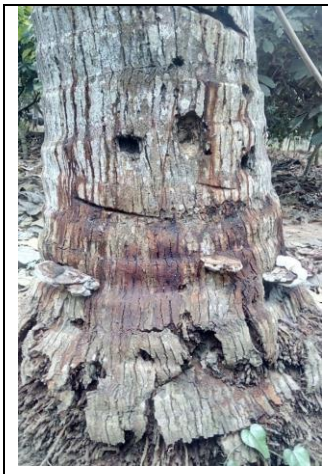

Plate 1. Symptoms of Basal Stem Rot.

Plate 1. Bleeding symptoms on coconut stem

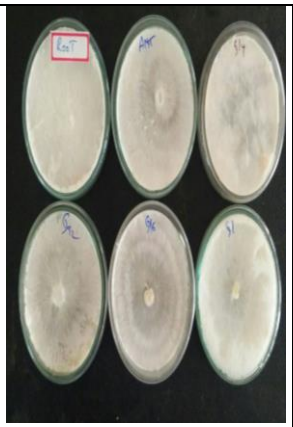

Plate 2. *Ganoderma* isolated from root and bark samples.

Plate 3. *In vitro* efficacy of Azoxystrobin 11% + Tebuconazole 18.3% SC W/W at 500 ppm against *Ganoderma* spp.

Plate 4. *In vitro* efficacy of Hexaconazole 5% + Validamycin 2.5% sc at 500 ppm against *Ganoderma* spp.

Plate 4. Root feeding with Hexaconazole 5% + Validamycin 2.5%

Plate 4. Root feeding with Azoxystrobin 11%+ Tebuconazole 18.3% SC

Field evaluation of selected combi fungicides

Based on the *in vitro* studies, the best chemical fungicides were forwarded to evaluate under field conditions. The treatments were followed with quarterly schedule for a period of 27 months to observe its affect on the disease (Table 3).

The treatment T6 - Root feeding of Hexaconazole 5% + Validamycin-2.5% SC @4 ml in 100 ml water + soil drenching @2ml/litre - 15 litre/palm recorded 40.75.00 % reduction over initial followed by the positive check T7: Root feeding with Hexaconazole @4 ml in 100 ml of water/Palm with 36.20 per cent reduction over initial. The next best treatment was T4- Root feeding of Hexaconazole + Validamycin 4 ml in 100 ml of water/palm showed 32.08 % reduction over initial. The remaining treatment are performed in the order of merit as T5- Soil drenching Hexaconazole 5% + Validamycin 2.5% SC @2ml/litre 15 litre/ palm followed by T3- Root feeding of Azoxystrobin 11% + Tebuconazole-18.3% SC @ 4 ml in 100 ml water + Soil drenching @ 2ml/litre - 15 litre/palm, T2 - Soil drenching of Azoxystrobin 11% + Tebuconazole 18.3% SC @ 2ml/litre - 15 litre/palm and T1- Root feeding of Azoxystrobin 11% + Tebuconazole 18.3% SC @ 4 ml in 100 ml water recorded 26.86%, 16.17% and 15.26% reduction over initial respectively (Table 3).

The present findings are in conformity with the results of Idris *et al.* (2007)., Ramli *et al.* (2022) and Naik (2023) who reported that basal stem rot

was effectively managed by Hexaconazole 5 % EC. Thangeswari *et al*. (2019) also reported similar findings that root feeding of triazole fungicides *viz*., Tebuconazole 25.9 % EC or Tetraconazole 3.8 % EW or Propiconazole 25 % EC or Hexaconazole 5 % EC @ 2 per cent at quarterly interval was found effective in reducing the basal stem rot disease intensity in coconut and resulted in increase in the yield of coconut.

Table 3: Evaluation of identified systemic fungicide against basal stem rot disease under field conditions.

Treatments	Disease index										Reduction over initial
	Pre treatmental data	3MAT Jan-21	6MAT April-21	9MAT July-21	12MAT Oct-21	15MAT Jan-22	18MAT April-22	21 MAT July-22	24 MAT Oct-22	27 MAT Jan-23	
T1	30.48 (33.49)	30.55 (33.50)	31.05 (33.84)	30.56 (29.02)	28.86 (27.28)	27.42 (31.52)	26.60 (31.02)	26.60 (31.02)	26.00 (30.60)	25.83 (30.49)	15.26
T2	33.44 (35.32)	33.48 (35.30)	33.71 (35.46)	32.87 (29.90)	32.48 29.65)	31.62 (34.15)	30.62 (33.54)	30.62 (33.54)	28.73 (32.17)	28.03 (31.74)	16.17
T3	34.06 (35.67)	33.96 (35.59)	33.28 (35.18)	32.56 (29.10)	32.05 (28.80)	28.94 (32.51)	27.78 (31.78)	26.84 (31.181)	25.93 (30.58)	24.91 (29.87)	26.86
T4	37.25 (37.60)	37.27 (37.59)	37.6 (37.79)	35.62 (30.66)	34.23 (29.87)	30.09 (33.25)	29.76 (33.04)	27.52 (31.61)	25.69 (30.37)	25.30 (30.11)	32.08
T5	35.58 (36.57)	35.81 (36.71)	36.1 (36.90)	35.71 (30.18)	34.42 (29.69)	31.52 (34.12)	30.68 (33.62)	29.20 (32.68)	25.95 (30.51)	25.56 (30.25)	28.16
T6	28.64 (32.29)	28.40 (32.15)	27.38 (31.49)	25.86 (25.06)	25.19 (25.06)	21.32 (27.42)	20.65 (26.97)	18.75 (25.57)	17.88 (24.88)	16.97 (24.17)	40.75
T7	41.96 (40.37)	40.94 (39.76)	39.05 (38.66)	37.23 (31.19)	37.11 (30.24)	32.46 (34.68	31.79 (34.29)	29.40 (32.82)	27.33 (31.48)	26.77 (31.12)	36.20
T8	39.07 (38.66)	40.90 (39.75)	41.36 (40.01)	42.69 (32.91)	43.56 (33.48)	44.69 (41.92)	45.35 (42.31)	45.69 (42.50)	46.75 (43.11)	47.09 (43.30)	0.00
SEm±	NS	1.39	1.18	1.11	1.04	0.92	0.71	0.718	1.13	1.15	
CD (P≤0.05)	NS	4.04	3.43	3.20	2.99	2.67	2.07	2.069	3.26	3.33	

CONCLUSIONS

Management of Basal stem rot disease in coconut with systemic fungicides were found highly effective as they can penetrate and spread to different parts of the plant. Root feeding of combi and systemic fungicides- Hexaconazole 5% + Validamycin-2.5% SC @4 ml in 100 ml water + soil drenching @2ml/litre- 15 litre/palm is found affective and advisable to manage the disease at field level.

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