Prevalence of Basal Stem Rot Disease of Coconut in Coastal Agro-Ecosystem of Andhra Pradesh

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Introduction

Coconut (*Cocos nucifera* L.) is one of the important plantation crops of high commercial value having great economic importance. India, with 1.78 million hectares under this crop with an annual production of 12597.3 million nuts is the third largest coconut producer in the world, after Philippines and Indonesia. In Andhra Pradesh, the coconut is grown in an area of 102500 ha. (2000-2001), with production of 992.5 million nuts. Coconut is essentially a crop of humid tropics and versatile in its adoptability in wide range of soil and climatic conditions. The natural habitat of coconut is the coastal belt of tropics where it is flourishing in sea washed littoral sand with constant motion of under ground current of water in soil atmosphere. Among the various fungal diseases affecting coconut palm in Andhra Pradesh, Basal stem rot (*Ganoderma*) disease caused by *Ganoderma applanatum* (Pers.) Pat., and *G. lucidum* (Leys) Kant. is the most destructive disease especially in light soils of Andhra Pradesh. The disease is also reported from Tamil Nadu (Tanjavur wilt), Karnataka (Anabe Roga), Kerala, Maharashtra, Gujarath and Orissa. (Thaskaran *et al.* 1994, Wilson *et al.* 1997)

Symptomatology

The pathogen first infects the root system and during the early stage of infection no external disease symptoms are clearly visible. Decay and death of the fine roots is the first underground symptom of the disease. The first characteristic visual symptom of the disease is exudation of reddish brown viscous fluid from basal portions of the stem. The bleeding patches begin from the base and extend up to three meters upwards as the disease progresses and discoloration in the stem can be seen upto the height of bleeding. In the crown, leaflets of outer most whorl exhibit wilting symptoms. Later on, one or two outer whorls of leaves turn yellow. They exhibit light to moderate browning followed by drooping. As the disease advances, the remaining leaves also droop down in quick succession leaving only the spindle with a new unhealthy leaves around. As the disease progresses, normal development of flowers and bunches is arrested, leading to button shedding and nuts become barren. Finally, all the leaves droop and fall out leaving the decapitated stem. Stem shrivels and dries up. Sporophores of the fungus (*G. lucidum*) appear at the base of the trunk in some palms prior to wilting or just after the death of the palm.

Distribution of basal stem rot disease in Andhra Pradesh

Coconut gardens in coastal agro-ecosystem of Andhra Pradesh were surveyed during the year 2000-2001. The disease incidence in general was observed maximum in light soils of coastal areas and the per cent disease incidence of Ganoderma wilt disease incidence on coconut palms was ranged between 1.21 and 62.5 per cent during survey (*Table-1*). The maximum disease incidence of upto 5.5, 21.0, 62.5 and 44.5 per cent was recorded in Krishna, West Godavari, East Godavari and Srikakulam districts of coastal ecosystem of Andhra Pradesh respectively. Ganoderma disease incidence was observed maximum in coconut gardens raised in sandy soil and red soil while negligible and no incidence was observed in coconut palms raised in black soils and on paddy bunds, fish/prawn pond bunds respectively. Number of rainy days and rainfall were

Table 1. Occurrence of ganoderma wilt disease of coconut in coastal districts of Andhra Pradesh

Name of District	Maximum percent disease intensity
*Krishna	5.5
West Godavari	21.0
East Godavari	62.5
Srikakulam	44.5

** Most of the coconut palms raised on paddy bunds*

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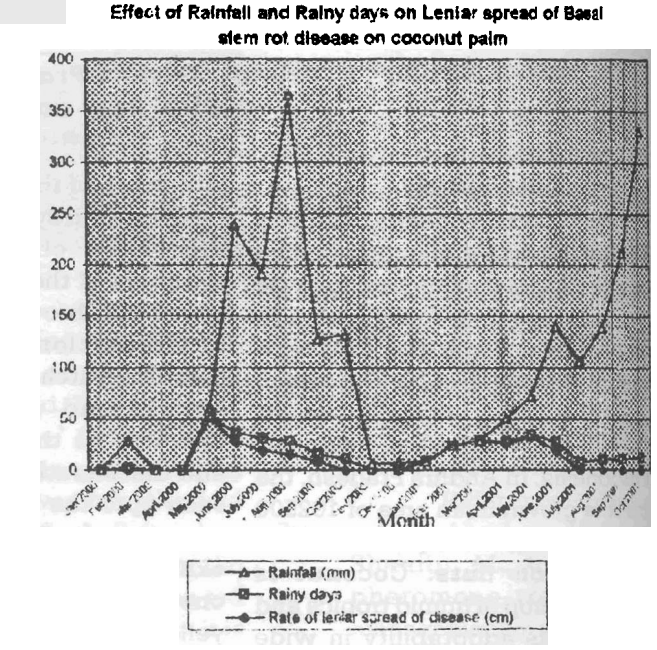
found to have negative relationship with leniar spread of Ganoderma wilt disease in coconut (*Graph -1*).

palm root tissues. However, the simple serological test failed to detect basal stem rot disease infection in stem

basal portion of stem and tissues at 1 meter height from basal portion of stem of BSR diseased coconut palm.

Graph 1. Effect of rainfall and rainy days on leniar spread of basal stem rot disease on coconut palm

Month	Rainfall (mm)	Rainy days	Rate of leniar spread of disease (cm)
Jan 2000	–	–	NR
Feb 2000	27	2	NR
Mar 2000	–	–	NR
April 2000	–	–	NR
May 2000	8	1	52
June 2000	202	10	27
July 2000	160	12	19
*Aug 2000	337	13	15
Sep 2000	112	7	9
Oct 2000	121	11	0
Nov 2000	5	1	0
Dec 2000	6	1	0
Jan 2001	–	–	9
Feb 2001	–	–	24
Mar 2001	–	–	29
April 2001	23	2	26
May 2001	38	1	33
June 2001	112	9	19
July 2001	99	7	0
Aug 2001	129	10	0
Sep 2001	202	10	0
Oct 2001	318	12	0



** During August, 2000 water stagnation due to Godavari Flood for a period of 5 days is recorded.*
NR = Data not recorded as experiment was initiated from May, 2002

Early detection by serological techniques

A reddish brown viscous fluid oozes from the stem referred to as bleeding is a typical characteristic symptom of the disease (Bhaskaran *et al.* 1994). Similar bleeding symptoms were also associated with the palms affected by stem bleeding disease caused by *Thielaviopsis paradoxa* (deseyness) Von Hohnel (Nambiar, 1994) and insect pests. Besides, in practice, it has been found that it is not possible to save the trees if the Ganoderma infection is advanced. Therefore, attempts were made to identify infection of basal stem rot disease by serological techniques. In simple serological test *i.e.*, Slide agglutination test (*Table-2*) and Glass capillary tube test (*Table-3*) the produced antiserum positively reacted (Precipitation formation) with cultures of *Ganoderma applanatum* and *Ganoderma lucidum* and with sap from Basal stem rot (BSR) affected coconut tissues of diseased coconut palm. Indirect form of ELISA (*Table-4*) was found to be sensitive in diagnosing BSR disease infection in tissues from root,

Bio-control of Ganoderma spp

Native biocontrol agent, *Trichoderma* spp were isolated from different soils collected from coconut

Table 2. Slide agglutination test for diagnosing Ganoderma applanatum, G. lucidum and Ganoderma infection in coconut

Antigen	Time taken for precipitation (Min.)* 15	30	45	60	75	90
G. applanatum	–	++	+++	+++	+++	+++
G. lucidum	–	++	+++	+++	+++	+++
Ganoderma diseased coconut stem bit	–	–	–	–	–	–
Ganoderma diseased coconut root bit	–	+	++	++	++	++
Healthy coconut stem bit	–	–	–	–	–	–
Healthy coconut root bit	–	–	–	–	–	–

** Data based on 15 observations each*
+ Precipitation (positive reaction)
- No precipitation

Table 3. *Glass capillary tube test for diangosing* Ganoderma applanatum, G. lucidum *and* Ganoderma *infection in coconut*

Antigen	Time taken for precipitation (Min.)*					
	15	30	45	60	75	90
G. applanatum	–	++	+++	+++	+++	+++
G. lucidum	–	++	+++	+++	+++	+++
Ganoderma diseased coconut stem bit	–	–	–	–	–	–
Ganoderma diseased coconut root bit	–	+	++	++	++	++
Healhty coconut stem bit	–	–	–	–	–	–
Healthy coconut root bit	–	–	–	–	–	–

Data based on 15 observations each

Precipitation (positive reaction)

No precipitation

Table 4. *Detection of basal stem rot pathogen* (Ganoderma spp.) *in various plant tissues of coconut by indirect form of ELISA*

Plant tissue/culture	Absorbance values at 405 mm*			
	Healthy		Disesaed	
	Range	Mean	Range	Mean
G. applanatum	0.15-0.121	0.119	0.412-0.415	0.413
G. lucidum	0.15-0.121	0.119	0.398-0.410	0.404
Tissues from root	0.141-0.146	0.143	0.222-0.311	0.274
Tissues from basal portion of stem	0.145-0.149	0.147	0.187-0.227	0.205
Tissues at 1 mt height from basal portion of stem	0.143-0.149	0.146	0.141-0.162	0.153

Conditions used Antigen = 10^{-1}; Rabbit antibody - 1:500;

Enzyme linked antirabbit Fc specific antibodies production goat 1:1000

gardens of Andhra Pradesh. *Trichoderma* spp. population was observed to be more in sandy soils and red soils (*Table*-5) (3 to 12 colonies/plate) with a soils PH ranging between 5 to 6 whereas the *Trichoderma* population was nil to one in black soils with soil PH ranging between 6.4 to 7.4. Isolated *Trichoderma* spp. was identified as *Trichoderma viride*, *Trichoderma harzianum* and *Trichoderma hamatum*. *Trichoderma viride*. *Trichoderma harzianum* and *Trichoderma hamatum* inhibited the growth of *Ganoderma applanatum* and *Ganoderma lucidum* on PDA under *in vitro* conditions. Field studies indicate that *Trichoderma viride* 50g + Neem cake 5 kg/palm/year treatment checked the leniar spread lesions of *Ganoderma* to maximum extent (22 cm) within a period of four months from the lesion size of 77.6 cm. Chemicals, zinc sulphate (2%), fungicides, copper oxychloride (0.1%), bordeaux mixture (1%), bitertanol (0.1%), tridemorph (0.1%) and garlic extract (10%) completely inhibited the mycelial growth of *Ganoderma applanatum* and *Ganoderma lucidum* on PDA under *in vitro* conditions. Zinc Sulphate (2%) enhanced the growth of three *Trichoderma* spp on PDA,. While copper oxychloride (0.1%), bordeaux mixture (1%), bitertanol (0.1%), tridemorph (0.1%) and garlic extract (10%) found to be inhibitory to *Trichoderma* spp. Development of fungicidal resistant strain of *Trichoderma* spp. is in progress.

Integrated methods for the management of basal stem rot disease of coconut are as follows.

1. The diseased part of the garden should be isolated from healthy area by digging isolation trench (1 meter deep and 0.5 meter width). Removal and burning of diseased and dead trees along with roots. The pit for replanting should be filled up with a mixture of soil and farm yard manure in equal quantities along with 5 kg neem cake.
2. Since the disease is more in light soils, the soil condition should be improved by raising green manure crops like sesbania, sunhemp and plouging them *in situ*. During rainy

Table 5. *Population of Trichoderma spp. in different soils of coastal agro eco-system*

Type of soil	No. of colonies/plate at dilution rate of 10^{-2}
Sandy soil of East Godavari	3 to 12
Black soil of Krishna	Nil to 1
Red soil of Srikakulam	6 to 8
Sandy soil of West Godavari	1 to 3

season each tree should be given farm yard manure (around 200 kg) and neem cake (5-10 kg).

3. Frequent watering/irrigation should be done during summer months. While irrigation, care should be taken to avoid flow of water from diseased trees to others. Basin system of irrigation to individual trees is thoroughly recommended.

4. Each bearing tree should recieve 2000g super phosphate and 3000g muriate of potash as chemical fertilizers and application of nitrogen should be given more as organic matter than in chemical form. Each palm should be given 50 g of Talc formulation of *Trichoderma viride* (a bioagent) mixed with 5 kg of neem cake per year to check the disease spread.

5. Drenching of soil (the basin) with 40 litres. of 1 per cent Bordeaux mixture per affected palm at 3-4 months interval is recommended. When the disease is noticed in very early stage, root feeding of the affected trees with 2ml Tridemorph in 25ml of water at quarterly interval is recommended to save the trees.

References

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What is biodiesel

Biodiesel is a fuel produced from renewable resources such as vegetable oils, tallow and waste oils and fats. It can be used pure or blended with fossil diesel fuel. Blends of two to 30 per cent do not require any modification to the car engine. With 100% pure biodiesel, minor modifications may sometimes be needed. The 00 repeseed variety (canola) is by far the biggest source of feedstock used for biodiesel production globally. With about 60 per cent mononunsaturated oleic fatty acid content and only about 6 per cent saturated fatty acids, it is stable and does not freeze in cold winter temperatures. New varieties (LZ 7632) are reaching even higher levels of up to 87 per cent oleic fatty acid. The variety of biodiesel feedstock has, however, broadened over time and other vegetable oils used in bigger volumes today are sunflower oil (in southern France and Italy), soyabean oil (in the USA) and palm oil (to fuel buses in Kuala Lumpur, Malaysia). In 1998/1999, high oilseed costs and record low prices for diesel fuel prompted the commercial production of biodiesel from recycled food oils from housefolds and restaurants. McDonalds in Austria for example, collects some 1,100 tonne of quality recycled frying oil from its 135 restaurants, which is then tranesterified into fatty acid methyl ester (FAME) of standardised quality for fuel.

How is biodiesel made ?

Biodiesel is made by mixing a vegetable oil or fat with an alcohol (usually methanol) in the presence of a catalyst to produce fatty acids (or methyl ester) and glycerine. The process is not new - transesterification has been used in the oleochemical industry for many years to produce methyl ester, which is an intermediate in fatty alcohol production. Differences will arise from the actual oils or fats fed into the process. With oils or fats with a high free fatty acid (FFA) content, say above 8 per cent, it becomes more difficult to properly separate the glycerol and esters, and the FFAs also affect the performance of the catalyst. The more saturated an oil or fat is (such as with tallow or waste frying oils which are hydrogenated), the more solid it is at low temperatures, making it unsuitable as a fuel in cold countries

Why biodiesel ?

The biodiesel industry stresses various factors which makes the fuel a credible alternative or addition to fossil fuels. Biodiesel is non-toxic, biodegrdable and non-flammable, making handling and storage safer. As a fuel, it is much lower in sulphur content than petrochemical diesel. It therefore burns more clearly and more completely, meaning less pollutants such as hydrocarbons, carbon monoxide and particulates. This gives both environmental and health benefits. Various studies have concluded that using 1 kg of biodiesel leads to the reduction of some 2.5 kg of CO_2. This represents a significant tool for the EU to meet its Co_2 emission reduction target contained in the 1997 Kyoto protocol on global warming and climate change. Particulate emission is reduced by an average of 50 percent, which is another critical environmental issue in big cities,

A US Environmental Protection Agency study has shown that using biodiesel instead of petroleum-based diesel offers an important percentage reduction in cancer risks from particulate matter emission exposure. In addition, biodiesel does not contain aromatic compounds, which include carcinogenic chemicals like benzene and toluene. In addition, biodiesel can reduce dependence on oil imports. The world's petroleum and natural gas resources are concentrated in OPEC countries, which hold 78 percent of the world's petroleum sources and 39 per cent of its natural gas sources.

World demand for fossil fuels also continues to rise and biodiesel offers a way to fill this gap.

-Oils & Fats International