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Survival of inoculum and initiation of infection in coconut nursery by *Phytophthora palmivora* Butl.

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Bud rot is a fatal disease of coconut palm caused by *Phytophthora palmivora* Butl., characterized by the rotting of the single terminal bud and surrounding tissues. Even though it affects palms of all ages, young palms in low land and moist situations are more susceptible to the disease. Butler (1906) first reported bud rot disease from India. Radha and Joseph (1974) reported a disease incidence of 1.2 to 10.9 per cent in Kerala, and 35 to 40 per cent in gardens having large number of palms in certain locations. Rasmi *et al*. (2004) reported that in hilly areas of Kasaragod, Kannur and Calicut districts, more than 50 % of the disease affected gardens in certain pockets face heavy losses due to bud rot disease. Exhaustive work has been done regarding the etiology and epidemiology of bud rot disease in adult palms (Thevenin *et al*., 1992; Brahmana *et al.*, 1992; Mangindaan *et al.,* 1992). However, limited information is available with regard to the nature of survival of the pathogen in coconut nurseries during off season.

Bud rot incidence was noticed in two of the seedling nursery plots of CPCRI during monsoon seasons. These two plots were identified for monitoring the survival of *Phytophthora palmivora* propagules in soil and host during pre monsoon (April-May), monsoon (June-July) and post monsoon (September-October) periods. Survival of the propagules in the basins of diseased and healthy seedlings was assessed by baiting with immature nuts of Chowghat Orange Dwarf (COD) in the field as well as in the laboratory. The petiole sheath tissues collected from the base of the diseased and healthy seedlings were scrapped with sterilized scalpel and slides were prepared for observing the surviving propagules of *P.palmivora*. Pieces of 5 x 5 mm size of the petiole sheath tissues and roots were plated in P_{10}ARP medium (Kannwischer and Mitchell, 1978).

The Disease Potential Index (DPI) of weeded and un-weeded area were estimated by "Serial end point dilution method" of Tsao (1960).The young spear leaf discs were used as baits for trapping *P. palmivora* propagules from the soil slurry.

Inoculations were done in the detached spear leaf to study the mode of entry into the spear leaf and to find out the effect of injury in causing infection. Leaf pieces of three growth stages were used for the study. These were characterized by cream, light green and dark green in colour. Inoculations were done with and with out wounding on these leaf pieces. *P. palmivora* discs of 5 mm dia. cut from the active growing portions of petri plate cultures were used for the inoculation.

The result of this study revealed that *P. palmivora* propagules are surviving in the soil and in the host plant in all the seasons (Table 1) and also the pathogen is active through out the year. One of the reasons for this could be the frequent irrigation provided and closer sowing of seed nuts in the nursery which help to maintain a high relative humidity in the plots. Higher rate of survival was in the monsoon compared to that of the other seasons. The pathogen surviving in the leaf sheath, soil and root can act easily as a readily available source of inoculum and thus can cause a fresh disease outbreak. In the host plant, the propagules were found to survive in the root and petiole leaf tissues covering the basal part of the seedling. The pathogen was found to survive in soil and the host tissues of both diseased and healthy seedlings. However, the rate of survival was found to be higher in the diseased seedlings compared to that in the healthy ones.

It was noticed that the disease incidence in the seedling nursery was high in the un-weeded area compared to that of the weeded one.This could be due to

Table 1. Survival of *P. palmivora* in coconut nursery

a) Soil

Season	Status of seedlings	Number of samples taken	Number of positive trapping with immature nuts	
			Trappings in the field	Trappings in the lab
Pre-monsoon (April-May)	Diseased	Nil	Nil	Nil
	Healthy	10	1	2
Monsoon (June-July)	Diseased	10	4	6
	Healthy	10	2	3
Post-monsoon (September-October)	Diseased	10	1	3
	Healthy	10	1	2

b) Petiole sheath tissue

Season	Status of seedlings	Number of samples taken	Number of positive trappings
Pre-monsoon	Diseased	Nil	Nil
(April-May)	Healthy	10	2
Monsoon	Diseased	10	6
(June-July)	Healthy	10	3
Post - monsoon	Diseased	10	4
(September- October)	Healthy	10	2

c) Roots

Season	Status of seedlings	Number of samples taken	Number of positive trappings
Pre-monsoon	Diseased	Nil	Nil
(April-May)	Healthy	10	1
Monsoon	Diseased	10	5
(June-July)	Healthy	10	3
Post-monsoon	Diseased	10	2
(September- October)	Healthy	10	1

the high relative humidity due to the presence of dense vegetation, preventing free movement of air and resultant low temperature in the un-weeded area compared to that of weeded area in the seedling nursery. DPI of Phytophthora in the un-weeded area was higher compared to that of weeded area in the seedling nursery (Table 2). This shows that the microclimate in the un-weeded area is ideal for the rapid multiplication of *Phytophthora* compared to that of weeded area (Kalmowitz *et al.*, 1991).This points to the importance of cleanliness in nurseries for preventing building up of *Phytophthora* inoculum in nurseries.

Detached spear leaf inoculation studies revealed that the leaf pieces which were cream in colour readily produced lesions within 48 h of inoculation even without infliction of injury. However, the leaf pieces which were light green to dark green in colour needed injury for the production of lesions. The absence of infection on inoculated mature leaves and the occurrence of quicker infection in the young leaf pieces suggest the tolerance of mature tissues to *Phytophthora*. Saraswathy (1993) reported a similar condition when *P. meadii* was inoculated in arecanut leaves of varying maturity. The inability of *Phytophthora* to infect mature leaves without wound is attributed to the mechanical barrier offered by the mature epidermal layers and heavy deposition of cuticular wax on the epidermal cells. On contact with host, *Phytophthora* produces enzymes like pectinase to dissolve the cell wall components. However, in young spear leaf the cells are immature with thin cell walls and thin cuticle deposition. So the mechanical barrier against the pathogen is very poor in young spear leaves compared to that of the mature leaves. Gustavo Roberto Manco (1974) reported that when cacao leaves of different maturity where inoculated with *Phytophthora*, it was found that on very young leaves the first lesion appear 24 h after inoculation, on leaves of intermediate maturity the first darkening appear after 36 h and on mature leaves the symptoms appear after 72 to 96 h and sometimes do not appear at all.

Table 2. Disease Potential Index of soil in weeded and un-weeded area in budrot affected coconut nurseries during monsoon

Soil from the base of	Un-weeded plot							Weeded (Clean plots)						
	Dilution of						DPI	Dilution of						DPI
	1/1	1/2	1/4	1/8	1/16	1/32		1/1	1/2	1/4	1/8	1/16	1/32	
	+	+	+	-	-	-	4	+	-	-	-	-	-	1
Healthy seedlings	+	+	-	-	-	-	2	+	+	-	-	-	-	1
	-	-	-	-	-	-	0	-	-	-	-	-	-	0
	+	-	-	-	-	-	1	-	-	-	-	-	-	0
	+	+	-	-	-	-	2	-	-	-	-	-	-	0
	+	+	+	+	+	-	16	+	+	+	-	-	-	4
	+	+	+	+	+	-	16	+	+	-	-	-	-	2
Diseased seedlings	+	+	+	-	-	-	4	+	+	+	-	-	-	4
	+	+	+	+	-	-	8	+	+	-	-	-	-	2

\+ sign indicates positive trapping of *P. palmivora*
\- sign indicates negative trapping of *P. palmivora*

Survival of *Phytophthora* in the petiole sheath tissue has great significance in the epidemiology of bud rot disease in nursery. The close proximity of spear leaf with petiole sheath tissue give a strong clue that presence of inoculum in the petiole sheath tissue is crucial factor in the infection of the spear leaf.

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