Plantation Crops Research and Development in the New Millennium (2002): 67-71

BREEDING FOR RESISTANCE/ TOLERANCE TO ROOT (WILT) DISEASE

R.V.Nair, P.M.Jacob, P.K.Koshy, M.Sasikala and K.U.K.Nampoothiri

Central Plantation Crop Research Institute, Regional Station, Kayangulam.
Krishnapuram P.O, Kerala-690533.

ABSTRACT

Root wilt is a serious disease of coconut in Kerala. The disease affects 16 million palms and cause an annual loss of 968 million nuts. Involvement of phytoplasma in the etiology of this disease has been established. Breeding for evolving root (wilt) resistant varieties – being the lasting solution for the disease is implemented since 1987. In the heavily diseased tracts, some high yielding west coast tall and chowgate green dwarf palms were found to be resistant and serologically negative under field conditions. Studies indicated that CGD palms were having higher level of resistance to the disease compared to that of other varieties. It has also been reported that CDO X WCT hybrids gave higher yield in spite of contracting the disease. Based on these observations, the following crosses are made – WCT X WCT (inter-se), WCT (self), WCT X CGD, CGD X WCT, CGD (self/inter-se), CDO (self/inter-se). The present crossing programme includes 63 WCT, 97 CGD and 4 CDO palms in the farmer's plots. The 2725 progenies were under planted among heavily infested palms for evaluating their resistance and use them as future mother palms. In the seventh year of planting, WCT (open pollinated) seedlings showed 60%disease incidence where as WCT (self) and WCT (inter-se) showed 45% disease incidence and only 31% in CGD X WCT. Four seed gardens have been established by planting 3371 artificially pollinated seedlings.

Root (wilt) is a serious disease of coconut affecting the coconut production. The disease is contiguously prevalent in eight southern districts of Kerala. The survey conducted, during 1984 indicated that the disease is prevalent in about 0.4 million ha causing an annual loss of 968 million nuts. The disease is caused by phytoplasma which is transmitted by the lace bug, *Stephanitis typica*. As the disease cannot be controlled by conventional plant protection measures, development of resistant / tolerant varieties is the most ideal and practical method for the management of the malady.

Studies on identifying coconut genotypes, resistant/tolerant to root (wilt) disease was initiated by Varghese (1934). The occurrence of high yielding palms among the heavily diseased palms was also reported by Davis (1953). He surveyed about 10 sq km, in and around Kayangulam and could not locate genotypes resistant to root (wilt) disease. Menon (1981) reported that open pollinated progenies of healthy palms from disease endemic areas had higher yield and lesser incidence of disease than the progenies from disease affected palms.

Rawther and Pillai (1972) reported from a survey that natural cross dwarf hybrid coconuts exhibited higher tolerance to disease as compared to West Coast Tall (WCT). Jacob *et al* (1998) also reported higher level of tolerance of COD X WCT hybrids to root (wilt) disease. Higher degree of resistance to coconut root (wilt) disease in Andamans Ordinary was reported by Radha (1961) and Mathai (1988).

A large number of exotic and indigenous cultivars including their cross combinations were screened for resistance to root (wilt) disease under field conditions by CPCRI (RS) Kayangulam. Nearly 84 cultivars and 68 hybrid combinations were evaluated and none of them were found to have the desired level of resistance to the disease. (Jacob *et al*, 1998). A com-

prehensive breeding programme for evolving resistant / tolerant coconut varieties is being implemented at CPCRI (RS) Kayangulam since 1987. (Nair M.K. *et al*, 1996). In an intensive survey in large number of farmer's plot in the hot spot districts of Alappuzha, Pathanamthitta, Kollam and Kottayam, 200 CGD palms were observed. It was found that 75% of them were disease free indicating that this variety is having higher level of resistance to root (wilt) disease when compared to other varieties.

From a screening trial of 8 exotic and 2 indigenous coconut varieties, carried out at CPCRI (RS) Kayangulam during 1988, it was found that Chowghat Green Dwarf (CGD) had the highest level of resistance after 6 years of planting compared to other varieties (Nair R.V. *et al.,* 1999). Thus the studies from the natural survey as well as from the screening trials confirmed the higher level of resistance of CGD to root (wilt) disease.

Breeding for resistance to coconut root (wilt) disease was initiated primarily based on the following observations:- 1) CGD is having higher level of resistance when compared to other varieties. 2) In the disease endemic areas, in the midst of heavily disease affected WCT palms, disease free and high yielding palms were found. These disease free palms were identified as the base material for the breeding programme.In disease endemic areas, a number of disease free and high yielding Chowghat Orange Dwarf (COD) palms were also found in the midst of heavily disease affected coconut palms. These are also included in the breeding programme to exploit the reported occurrence of high yield and tolerance to the disease in COD X WCT hybrids. Selection criteria of mother palms for pollination are given in Table1.

Table 1. Selection criteria of parental palms

1. West Coast Tall (WCT)

a) Parental palms should yield 80 or more nuts per year

b) Palms should be regular bearers and absolutely free from all disease and pests.

c) Palms should be more than 40 years old and surrounded by palms of which at least 80% are affected by the root(wilt) disease in an endemic area.

d) Tall mother palms should have typical WCT characters. Twenty five open pollinated seedlings are grown from each mother palm and all progeny seedlings should show uniform vigour and colour characters of WCT. This progeny test is done to cull out hybrid mother palms, if any.

e) Palms should be negative in their reaction to the root(wilt) antiserum and the serological tests are to be repeated every year.

Table 2. Locations of mother palms

District	Locations of mother palms
Alappuzha	Kayangulam
	Chengannur
	Haripad
	Muthukulam
Pathanamthitta	Kallooppara
	Thiruvalla
	Kozhencherry
	Ayroor
Kollam	Oachira
	Karunagapally
	panmana
	Edappallykota
Kottayam	Changanacherry
	Kottayam
	Kumarakom
	Vaikom

Table 3. Number of mother palms used for artificial pollination

Year	WCT	CGD	CDO	Total
1988-89	22	3		25
1989-90	30	6		36
1990-91	24	8		32
1991-92	40	8		48
1992-93	67	10	5	82
1993-94	104	5		109
1994-95	95	30		125
1995-96	85	20	4	109
1996-97	76	111	9	196
1997-98	76	119	9	204
1998-99	69	80	10	159
1999-00	63	97	4	164

2. Chowghat Green Dwarf (CGD)/Chowghat Orange Dwarf (COD)

a) Parental palms should be atleast 20 years of age and above.

b) Palms should preferably yield 80 nuts or more per year.

c) Palms should show typical CGD/COD characters with regard to stem, crown, leaf and nuts.

d) Palms should be preferably healthy and free from all disease and pests and surrounded by palms of which atleast 80% are affected by the root(wilt) disease, in an endemic area.

e) The palms should be negative in their reaction to the root(wilt) antiserum. The serological tests are to be repeated every year.

Artificial pollination of mother palms were carried out in farmers plots located in the hot spot districts of root (wilt) disease, with a view to produce artificially pollinated progenies which can be used either for developing a root (wilt)resistant/tolerant variety or for the production of parental materials for establishing seed gardens. Details of areas surveyed and location of mother palms are given in Table 2.

The following cross combinations were carried out :

WCT (interse).
WCT (self).

Table 4. Aritificial Pollination carried out in farmer's plots.

Year	Inflorescence	Buttons
1988-89	88	2481
1989-90	225	4740
1990-91	135	3058
1991-92	230	3818
1992-93	386	7469
1993-94	464	9218
1994-95	546	12173
1995-96	465	10401
1996-97	549	13973
1997-98	275	6769
1998-99	233	5113
1999-00	565	13769

Table 5. Artificially pollinated nuts collected from farmers plot

Year	Nuts collected
1989-90	366
1990-91	791
1991-92	747
1992-93	1300
1993-94	1122
1994-95	2107
1995-96	2480
1996-97	3115
1997-98	3236
1998-99	2568
1999-00	3460

Table 6. Seedlings Planted for Screening at CPCRI, Kayangulam

YEAR	BLOCK	WCTxWCT			WCTx CGD	WCT	CGDx WCT	CGDx CGD	CDOx CDO	TOTAL
		BP	MP	SELF	TxD	OP	DxT	DxD	DxD	
1991	4	74					31			105
1992	1,4	286	172	79		20	14	20		591
1993	4,6,7	86	206	46		124		24		486
1994	3,5,6,11	105	390	53		47	88	24		707
1995	3,4,5	257		15	23	40	15			350
1996	2,3	37		77	26	36	44			220
1997	6,7	166			65					231
1999	3,5,8								35	35
TOTAL		1011	768	270	114	267	192	68	35	2725

BP - Biparental; MP - Mixed Pollen; OP - Open Pollinated

Table 7. Yield of CGD x WCT hybrids

Year of planting	-	1991
No. of plants	-	26
Initial year of flowering	-	1995
Mean yield	-	60.5
Range of yield values	-	2 to 156

WCT X CGD.
CGD (self/interse).
CGD X WCT.
COD (self/interse).

Yearwise details of the number of palms under pollination are given in Table3. The mother palms are serologically tested every year to ascertain their freedom from disease. Details regarding the pollination of mother palms and nuts harvested are given in Table 4 and 5 respectively.

Artificially pollinated seedlings of the above cross combinations, were under planted since 1991in the normal spacing of 7.5m X 7.5m in different blocks of CPCRI(RS) , Kayangulam where more than 80% of the existing palms were affected by root (wilt) disease.(Table6). Care was taken to see that the old diseased palms were retained at least for six to seven years after under planting of the seedlings, to provide sufficient inoculam for natural infestation under field conditions. Heavy incidence of root (wilt) disease was observed for under planted seedlings under field conditions. The under planted seedlings were removed as and when they took up infection and the same pit was replanted with the new artificially pollinated seedlings for screening.

At CPCRI(RS) Kayangulam, 2725 seedlings have been planted since 1991 and the details are given in Table 6. Observations on 31 numbers of CGD X WCT progenies planted during 1991 revealed that the hybrids came to flowering in 40-50 months after planting and have yield potential of over 80 nuts/palm/year in the full bearing stage. Details regarding the yield obtained during the initial years of bearing are given in Table7. The copra content was 250gm/nut (Jacob.et al, 1999). Observation on the root (wilt) incidence eight years after planting indicated that 41% took up disease. On the other hand observations on the performance of 50 CGD X WCT hybrid progenies brought from disease free area (Kasargoad) and planted at Kayangulam indicated that 60% of them took up disease at the 6th year of planting. This has highlighted the scope of developing CGD X WCT hybrids from the disease free CGD and WCT palms in the disease endemic areas as the ideal planting material.

Table 8. Disease Incidence in Seedlings planted During 1992

Cross combinations	Year of planting	No. of seedlings planted	NO.of iseased seedlings	% RWD
CGDxWCT	1991	31	13	41.9
WCT(MP)	1992	118	53	44.9
WCT(OP)	1992	20	12	60.00
WCT(SeLf)	1992	37	18	48.6
WCTxWCT	1992	105	47	44.8

Table 9. Seedlings planted for establishing seed gardens

Location	Years of start	No. of seedlings planted				Total
		WCTxWCT	WCT self	CGDxCGD Interse/selfed	CGDxCGD Interse/selfed	
CPCRI(RC) Kannara	1995	655	285	250		1190
CDB Farm Neriamangalam	1996	334	108	149	56	647
DA Farm Mavelikkara	1999	247	187	556	142	1132
Africultural Farm, karunagapally	2000	9	117	235	51	402
Grand Total		1245	687	1190	249	3371

The first batch of progenies planted during 1992 are in the initial stages of flowering and nearly 93 of them have so far flowered.. Disease incidence of seedlings planted during 1991 and 1992 are given in Table 8. It can be seen that artificially pollinated seedlings were superior to open pollinated seedlings of West Coast Tall . There were no significant differences between the selfed/interse-mated progenies of West Coast Tall. The CGD X WCT hybrids were most promising with regard to disease resistance followed by self / interse progenies of WCT. WCT (OP) progenies had the maximum incidence of root (wilt) disease.

Promising selections, out of the artificially pollinated progenies of WCT planted at CPCRI (RS) Kayangulam, will be further selfed/interse mated to develop through recurrent selection, a high yielding and disease resistant/ tolerant WCT variety for the root (wilt) prevalent tract. They will also be used as nucleus seed garden for the production of quality seedlings.

Establishment of seed gardens. In order to meet the acute shortage of quality planting materials in the root (wilt) prevalent tract, efforts were made for large scale production of quality planting materials. Towards this end , selfed/interse progenies of WCT and CGD mother palms have been planted for establishing seed gardens. 3371 seedlings spread over nearly 50 acres have been established in the four root (wilt) districts located in the diseased tract (Table 9).

These seed gardens, when they come to the full bearing stage, are expected to produce nearly 2 lakhs seedlings/annum (@40 seedlings/ palm/year for 5000 parental seedlings already planted) which will go a long way in substantially meeting the acute demand for quality planting materials in the disease prevalent tract. We have plans to establish similar seed gardens in the four remaining root (wilt) prevalent districts. Gram Panchayaths will be contacted for additional land for planting in second phase.

ACKNOWLEDGEMENT

Thanks are due to Dr. M.K.Nair, Ex. Director and Dr. R.D.Iyer, former Head, Division of Crop Improvement CPCRI, Kasargoad for their guidance and encouragement.

REFERENCES

Davis, T.A. 1953. *Indian Cocon. J.,* **6**(3) 95-100.

Jacob, P.M., Nair, R.V. and Rawther, T.S.S. 1998. Varietal resistance. In coconut root (wilt) disease ed. K.U.K.Nampoothri and P.K.Koshy, CPCRI, Kasargoad, pp 97-104.

Jacob, P.M., Iyer, R.D., Nair, R.V. and Nampoothri, K.U.K. 1999. CGD X WCT hybrid- an ideal planting material for root (wilt) disease endemic areas . abstract presented in Annual Symposium on plant disease management for sustainable agriculture. 14th – 16th Dec 1999 held at CPCRI(RS) Kayangulam.

Mathai, G., Mathan, J. and Balakrishnan, B. 1988. Reaction of exotic varieties and exotic cultivars of coconut to root (wilt) disease of Kerala, National Symposium on coconut breeding and management held on Nov 23-26. Kerala Agri. University, Thrissur, India. Abstract of paper p19.

Menon , K.S., Thommen, K.J. and Sukumaran, A.S. 1981. Varietal resistance studies In : Review of Research on coconut root (wilt) disease. Central Plantation Crops Research Institute, Kayangulam. pp 78-82(mimeo).

Nair, M.K., Koshy, P.K., Jacob, P..M., Nair, R.V., Bhaskar Rao, E.V.V., Nampoothri, K.U.K. and Iyer, R.D. 1996. *Indian Naleekera Journal,* **25**(7) p2-6.

Nair, R.V., Jacob, P.M. and Ajith Kumar. 1999. Screening of coconut varieties against root (wilt) disease. Abstract . annual meeting and symposium of Indian Phytopathology society (Southern Zone) held on 14-16 December 1999 at CPCRI (RS) Kayangulam.

Radha, K. 1961. Leaf rot disease of coconut. Poroc 1st Seminar. FAO Tech. Wkg. Pty.Cocon. Prod.Prot. and Process. Trivandrum:30.

Rawther, T.S.S. and Pillai,R.V. 1972. *Indian J.Agric.Sci.* **42**:747-749.

Varghese, M.K. 1934. Disease of coconut palm. Supdt,. Govt. Press, Trivandrum pp.105.