RELATIVE DROUGHT TOLERANCE AND PRODUCTIVITY OF RELEASED COCONUT HYBRIDS

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Abstract: Eightyseven coconut hybrids comprising of 21 different Tall x Dwarf, 10 Dwarf x Tall, 51 Tall x Tall, 4 Dwarf x Dwarf and one three way hybrid were studied. Evaluation at 18th year based on cumulative yield, which is representative of true yield potential, was carried out and three hybrid combinations namely, Chandrasankara (CDO x WCT), Chandralaksha (LO x CDO) and Lakshaganga (LO x GB) were identified as superior hybrid combinations. These hybrid combinations gave 19 to 42% more yield over the commonly cultivated WCT. Among these three hybrids, Chandrasankara (CDO x WCT) was found to give 47% higher copra over WCT. Hybrids Lakshaganga (LO x GB) and Chandralaksha (LO x CDO) performed well under drought situations. The drought tolerance in these hybrids was identified to be the contribution from the female parent Lakshadweep Ordinary. The performance of these three hybrids in relation to other hybrid combinations and drought situations is discussed.

INTRODUCTION

At CPCRI, Kasaragod hybrid evaluation programmes were initiated in early 1950s. Different combinations of hybrids namely Tall x Dwarf (21 different combinations) Dwarf x Tall (10 combinations) Tall x Tall (51 combinations) and Dwarf x Dwarf (4 combinations) and three-way hybrid (1 combination) were planted between 1955-66, 1966-67, 1972-73 and 1981-82. While the earlier hybrids, planted during 1955-56, are in different plots under different management practices, the 1966-67 hybrids were planted in a single plot and are being maintained under uniform management conditions for the past 21 years. Based on the superior performance at the end of 18th year some of these hybrids COD x WCT (Chandrasankara), LO x COD (Chandralaksha) and LO x GB were recommended for release in Kerala in 1985 (Anon, 1986). As these plants have reached stabilized yield, their performance in relation to their productivity and in drought situations was analysed and presented in this paper.

MATERIALS AND METHODS

Five hybrid combinations namely, COD x WCT, WCT x COD, WCT x GB, LO x COD, LO x GB along with WCT which are planted in individual blocks in a single plot in "Hill Block East" at CPCRI, Kasaragod, were selected for evaluation. The population in each of the combinations varied from 10 to 18 and only such of those palms with known parentage and planted in the single year were used in this study. The soil type in this plot was red clay loam. All the palms were grown under rainfed conditions without cover crop till 1984 (till the end of 18th year of planting) and subsequently for the past three years cover crop has been raised in this plot. The palms received uniform fertilizer doses of 500 g N, 320 g P_2O_5 and 1200 g K_2O in split doses each year. The flowering age, number of bunches produced in a year, number of female flowers in each of the bunch and number of nuts in each bunch were recorded for all the palms. While computing the averages all the palms in a plot were considered and not the bear-

ing palms alone, in order to arrive at a reliable conclusion on population basis. The copra content was determined for each palm based on the samples (4 nuts per palm) drawn during summer months when the variation was found to be least (Mathew *et al.*, 1978).

RESULTS AND DISCUSSION

Flowering and yield performance

Among the five hybrid combinations, maximum number of palms came to bearing in the sixth year was in COD x WCT while in LO x COD maximum number of palms came to flowering in the eighth year. The average age at bearing was comparatively less in WCT than the remaining four Tall x Dwarf combinations namely, WCT x COD, WCT x GB, LO x COD and LO x GB (Table 1). Combinations involving LO as the female parent were comparatively late bearers than those which had WCT as female parent. When all the combinations are considered, 97 per cent of the palms came to bearing at the end of 10th year and the remaining in the 11th year. Precocity in bearing of COD was possibly inherited in hybrids only when it was used as female parent in COD x WCT combinations. In both the combinations (LO x COD and WCT x COD) where it was used as male parent maximum number of palms came to bearing only in the 8th year.

Yield performance at the end of 21st year is presented in Table 2. COD x WCT with 1200 nuts per palm average cumulative yield was superior to WCT by about 42 per cent. All the hybrid combinations gave higher cumulative yield than the WCT, except WCT x GB which recorded slightly lesser yield than WCT. Stabilized yield (1984-87) of these hybrid combinations ranged between 66 nuts/palm/year in WCT x GB to 101 in LO x GB. COD x WCT gave highest copra out-turn with 20.8 kg per palm per year which is about 52 per cent more than WCT. Both the hybrid combinations with LO as female parent also gave 42 and 45 per cent higher yield in terms of copra than WCT. The copra yield of WCT x GB was poorer by 11 per cent. In order to understand the stability of performance over a period of time the yield of last 10 years (1978-87) was considered (Table 2). Yields were higher during alternate years commencing 1978. In 1980 and 1984 there was marked decline in yield in almost all the combinations. To an extent the yields in 1982 were also poorer in almost all the hybrids as well as WCT.

Performance of hybrid during drought situations

In order to understand the fluctuations in the yield, the data on rainfall and number of rainy days during November of the previous year to May of next year were examined (Table 3). During the past 10 years, 1979 has only 168.8 mm rainfall and 6 rainy days (November 1978 to May 1979). During 1983, only 5 mm rainfall was received with only one rainy day. These two years can be classified as drought years. Therefore, the yield reduction in 1980 and 1984 could be the direct effect of extended period of drought during the preceding years. This is in agreement with the observation made by Mathew *et al.*. (1988) that the duration of drought period affects the yield of coconut in the succeeding two years. They also stressed that the length of dry spell is more important than the total rainfall *per se*. The yield of 1982 was also as poor as that of 1984 in almost all the combinations. Even though 219.6 mm rainfall was recorded from November 1980 to May 1981, from February to April was a total dry spell. Even out of the three rainy days recorded during April/May months substantial quantity

Table 1. Performance of hybrids at the end of 21st year of planting

Hybrid/ variety	Age at bearing	Average cumulative yield		Average annual yield 1984-87		Copra yield	
		no. of nuts/ palm	% WCT	No. of nuts/ palm	% WCT	kg/ palm	% WCT
COD x WCT	6.6	1200	42	99.8	36	20.8	52
WCT x COD	7.1	1019	21	88.4	20	17.5	28
WCT x GB	7.1	822	-2	65.7	-11	12.4	-10
LO x COD	8.6	1016	21	99.3	35	19.4	42
LO x GB	7.4	1079	28	101.3	38	19.8	45
WCT	6.9	840	-	73.5	-	13.7	-

Table 2. Yield performance of hybrids during the past 10 years (1978-1987), nuts/palm

Year	COD x WCT	WCT x COD	WCT x GB	LO x COD	LO x GB	WCT
1978	69.1	68.8	66.9	87.5	69.5	59.2
1979	111.0	86.4	69.7	113.3	81.1	76.2
1980	28.1	12.2	13.8	40.3	36.9	23.0
1981	126.8	102.3	92.8	77.9	96.5	87.0
1982	20.4	26.8	21.5	68.4	55.4	28.3
1983	150.7	147.6	105.6	97.8	99.3	94.6
1984	15.5	22.6	11.5	67.5	49.2	28.2
1985	148.5	135.0	105.7	96.7	146.6	102.4
1986	447.1	82.2	27.9	141.2	93.3	57.7
1987	188.0	113.6	117.6	91.6	116.2	105.8

of rain was received only at the end of May, on 30th and 31st. In effect February to May can be considered as non-rainy months. These five months of extended dry spell have adversely affected the yield of 1982. In addition to 1980, 1982 and 1984 to some extent 1978 and 1986 also showed lesser yields than the preceding and succeeding years. The rainfall and the number of rainy days were comparatively better in both 1977 and 1985 and these reduction could be attributed to the tendency of hybrids to give lesser yield succeeding

Table 3. Rainfall and number of rainy days during November - May*

Year	Nov-May rainfall mm	No. of rainy days	No. of rainy days in Apr/May	Non-rainy months	
1977	411.0	22	9	Jan, Feb	(2)
1978	886.1	35	20	Jan-Mar	(3)
1979	168.8	6	1	Jan-Mar,May	(4)
1980	290.5	21	11	Jan-Mar	(3)
1981	219.6	11	3	Dec, Feb-Apr	(4)
1982	152.9	12	6	Dec-Apr	(5)
1983	5.0	1	1	Nov-Apr	(6)
1984	441.1	20	9	Dec, Feb	(2)
1985	377.7	17	13	Dec, Feb	(2)
1986	209.5	11	3	Jan, Feb	(2)
1987	264.6	10	3	Jan-Apr	(4)

(* November of previous year to May of current year)

to a bumper crop in the previous years. However, when these years coincide with drought conditions in the preceding year, the effects appear to be much more pronounced as noticed in the case of 1980, 1982 and 1984.

For understanding the stability of performance of these hybrids the yield data for good years (1979, 1981, 1983, 1985 and 1987) and bad years (1978, 1980, 1982, 1984 and 1986) were analysed separately (Table 4).

During the drought influenced years least number of bunches (6.1 per year) was recorded in COD x WCT which accounted for 42 per cent reduction in the number of bunches. Highest reduction in number of bunches was recorded in WCT x GB (45%) and to an extent WCT x COD also showed greater reduction in number of bunches (31%) compared to LO x COD and LO x GB (19 and 21% respectively). The order of reduction in number of female flowers per bunch due to drought influence is comparatively less. LO x COD has recorded more number of female flowers during the drought influenced years (11%) while in all the remaining hybrids and WCT the order of decrease in female flowers during the drought influenced years ranged between 11 per cent in LO x GB to 26 per cent in WCT x GB. The setting percentage also was influenced due to the drought situation in the preceding year. In COD x WCT higher reduction to an extent of 43 per cent was noticed, while in LO x COD the reduction was only 5 per cent. In the remaining hybrids and WCT the setting was lower by 22 to 30 per cent during the drought influenced years.

Drought influence was much more

Table 4. Performance of hybrid during good and drought influenced years

	Characters	COD x WCT	WCT x COD	WCT x GB	LO x COD	LO x GB
Number of bunches	Good years	10.5	10.4	9.9	9.5	9.8
	DI years	6.1	7.2	5.1	7.7	7.7
	% reduction	42	31	45	19	21
No. of female flowers/bunch	Good years	35.0	32.5	33.3	26.8	30.1
	DI years	27.4	24.5	24.5	29.9	26.7
	% reduction	22	25	26	+11	11
Setting %	Good years	39	35	30	37	37
	DI years	22	25	21	35	29
	% reduction	46	29	30	5	22
Yield, nuts/ palm	Good years	145	117	98	95	108
	DI years	36	43	28	81	60
	% reduction	75	64	72	15	44

DI = Drought influenced years

pronounced on the yield of nuts than other characters which have been described above. The reduction in the bunches, female flowers and setting percentage together contributed to a variation of 75% in yield between the good years and drought influenced years in COD x WCT. However, this hybrid combination recorded highest number of nuts during the good years (145 nuts/palm/year). Further it also performed better with 36 nuts/palm/year than WCT x GB in which only 28 nuts/palm/year were recorded during drought influenced years. The best yield performance during the drought influenced years was recorded in LO x COD and LO x GB which had 81 and 60 nuts per palm per year.

The above characters clearly indicated that LO x COD has been least influenced by drought situation and the reduction in drought influenced years was only 19 per cent in number of bunches, 5 per cent in setting percentage and 15 per cent in over all yield, as compared to the reduction of 42 per cent in bunches, 46 per cent in setting percentage and 75 per cent over all yield in COD x WCT. Similarly, the hybrid combinations WCT x COD and WCT x GB also showed greater fluctuations between the drought influenced and good years for these parameters than LO x GB. Even though LO xGB has recorded 44 per cent reduction in yield, the annual yield at stabilized stage is about 38 per cent more than WCT in terms of number of nuts and 45 per cent more in terms of copra yield, which is higher than the LO x COD hybrid in both the annual yield and copra outturn. However, viewed from the angle of drought influence , the performance under drought situations was better with LO x COD exhibiting greater tolerance but higher yield potential.

This is also supported by the study of Rajagopal *et al.* (1988) who have recorded higher epicuticular wax content (EWC), low stomatal frequency and high leaf diffusive resistance in LO x COD and classified it as drought tolerant type among the genotypes studied by them. The hybrids WCT x COD and WCT x GB are more prone to the drought influence. In addition, their over all performance in terms of average annual yield and copra yield is lesser than COD x WCT, LO x COD and LO x GB. Thus the performance of LO x COD and LO x GB in the drought situations and over all performance of COD x WCT over a period of time appeared to be superior to the other combinations.

Only the combinations of LO as female parent have shown the drought tolerance as well as better yield performance during the drought situations. It is presumed that the drought tolerance is inherited only from LO parent and not from either of the male parents (COD and GB). This is borne out of the fact that WCT x COD or WCT x GB had shown and recorded greater influence of drought on yield performance. Further it may also be mentioned that among these two dwarfs GB is more susceptible to drought as wherever GB is involved as male parent, the performance of the hybrid is inferior to the hybrids with COD as male patent. Similarly, COD x WCT even though in terms of yield was superior, was found to be highly susceptible to the drought influence. This also rules out the possibility of either of the parents namely, COD or WCT having drought tolerance. Hence, among the parents used in the hybrid combinations in the present study only LO appears to have the possible tolerance to drought influence. This specifically indicates the possibility that with careful selection in the parentage it is possible to combine the drought tolerance and high yield in coconut breeding programmes and raise a hybrid genotype which can perform in a stable manner under fluctuating rainfall pattern. In a perennial crop like coconut which has a life span of 60 years it is essential to breed varieties for drought tolerance and other abiotic stresses.

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