

COMPARATIVE STUDY OF COCONUT GENOTYPES FOR COMPONENTS OF PHOTOSYNTHESIS AND RESPIRATION

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ABSTRACT

The three coconut genotypes, West Coast Tall (WCT), Chowghat Dwarf Orange (CDO) and the hybrid WCT×CDO (T×D) were compared for the rate of apparent photosynthesis, dark respiration, chlorophylls *a* and *b*, total carotenoids, relative assimilation rate (RAR), leaf area, and stomatal frequency. With the exception of WCT, the rate of photosynthesis was not correlated with yield. There was significant difference in the rate of photosynthesis between T×D and WCT. CDO exhibited higher dark respiration as compared to WCT and T×D. T×D had significantly higher amounts of total chlorophylls than WCT and CDO. Stomatal frequency was not related with the rate of photosynthesis. The total leaf area of T×D was the highest followed by WCT and CDO. The results indicate that the total leaf area might be an important factor determining productivity.

INTRODUCTION

The coconut palm exhibits wide variability in the production of nuts. Of the common cultivars of India the West Coast Tall (WCT), Chowghat Dwarf Orange (CDO), and the hybrid between WCT and CDO (T×D), the T×D is superior in yield.

Chacko Mathew and Ramadasan (1975) reported a significant positive correlation between the rate of apparent photosynthesis and annual yield of nuts in WCT. The present paper reports the results of a comparative study of photosynthetic rate, rate of dark respiration, stomatal frequency, relative assimilation rate, and the chlorophylls, in WCT, CDO and T×D genotypes.

MATERIALS AND METHODS

Adult coconut palms (35-50 years of age) growing in the Institute campus under similar soil conditions were selected for the study. Twenty palms each of WCT, CDO and T×D including low, medium

and high yield groups were chosen, on the basis of their mean yield during the past ten years. The study was carried out between October and November, 1981.

The youngest fully expanded leaf was sampled at 8.30 a.m. daily and apparent photosynthesis was determined manometrically (Chacko Mathew & Ramadasan, 1974). Measurement of dark respiration was done by Warburg's direct method (Umbreit, Burris & Stauffer, 1972). Chlorophylls *a* and *b* were determined spectrophotometrically following the method of Mackinney (1941). Carotenoids were estimated in the same extract according to Jensen and Jensen (1971). The stomatal frequency and stomatal index were determined after peeling off the epidermis by boiling the leaf bits in 10 per cent nitric acid in the presence of potassium perchlorate (oxygen salt). Staining was done in safranin for microscopic observations. The mean stomatal count of ten fields was used for estimating stomatal frequency. Relative assimilation rate was estimated by collecting leaflet samples from the youngest fully opened leaf at intervals of one month (Ramadasan *et al.*, 1984) and determining growth by using the formula of Watson (1947). Leaf area estimation was done using Li-3000 Li-Cor electronic leaf-area-meter.

RESULTS AND DISCUSSION

The photosynthetic rate was significantly higher in T×D than in WCT and CDO. Although CDO exhibited a higher rate of photosynthesis as compared to T×D, it showed a higher rate of dark respiration also, thereby nullifying the advantage of the high rate of photosynthesis. This was reflected in the annual yield of nuts. In the case of T×D, not only was the photosynthetic rate higher but also the dark respiration was relatively less resulting in higher relative assimilation rate. Further, it may be noted that the T×D possesses a larger photosynthetic area (6.8 m²/leaf) as compared to WCT (4.5 m²/leaf) and CDO (3.6 m²/leaf), resulting in higher rates of dry matter production (Table 1).

Data on chlorophyll pigments presented in Table 1, would show that T×D recorded significantly higher values than both WCT and CDO.

Table 1. Rate of apparent photosynthesis, dark respiration, relative assimilation rate and other characters in three coconut genotypes

	WCT		CDO		T×D	
	Mean	CV%	Mean	CV%	Mean	CV%
Rate of apparent photosynthesis ($\mu\text{lO}_2/\text{evolved}/\text{cm}^2/\text{h}$)	28.11	22.0	32.82	30.2	33.98*	14.0
Dark respiration (μlO_2 consumed/ cm^2/h)	4.23	24.4	6.31	11.8	5.02**	21.5
Relative assimilation rate ($\text{g}/\text{m}^2/\text{week}$)	2.83	44.1	2.63	38.8	4.7**	23.4
Total chlorophylla (mg/cm^2)	0.05	30.0	0.04	15.0	0.06**	16.0
Total carotenoids (mg/cm^2)	0.02	36.0	0.02	20.0	0.03**	17.0
Stomatal frequency (No./ mm^2)	199.06	10.3	189.50	19.3	203.59	14.0
Leaf area (m^2/leaf)	4.5	—	3.6	—	6.8**	—
Mean yield (No. of nuts/palm/year)	58.3	26.4	48.6	33.3	93.1	51.5

**Significant at 1% level.

*Significant at 5% level.

No significant variability was noted in the stomatal frequency among genotypes.

The T×D stands out in two important components, namely, the Relative Assimilation Rate (RAR) and the leaf area. The RAR has shown a significant positive correlation with yield in WCT also (Ramadasan *et al.*, 1984).

The importance of using the rate of dry matter accumulation and leaf area in the selection of one-year-old seedlings of WCT was shown by Ramadasan *et al.* (1980). The results show that T×D is superior to both its parents in all the components studied. The possibility of using these parameters for early identification of T×D hybrids, is being examined.

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