Journal of Plantation Crops 18 (Supplement) : 104–107

COMPARISON OF PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS OF COCONUT HYBRID SEEDLINGS

S. R. VOLETI, S. SHIVASHANKER and V. RAJAGOPAL
Central Plantation Crops Research Institute, Kasaragod 670 124, *Kerala, India*

ABSTRACT

Annual rate of leaf production, leaf area, leaf dry weight, increase in height and girth of four year old seedlings of MYD x WCT were higher than those of COD x WCT and MOD x WCT. Activities of enzymes such as nitrate reductase and malate dehydrogenase was higher in MYD x WCT whereas that of acid phosphatase and glutamic-oxalic acid transaminase more in COD x WCT. Thus under irrigated conditions, the superiority of MYD x WCT hybrid from nursery stage is being maintained over the other two hybrids.

INTRODUCTION

The relationship between the seedling characters and the yield of adult palms was reported in coconut (Liyanage, 1959) and oil palm (Tan and Handon, 1976). Recently Shivashanker and Kasturibai (1988) reported certain selection criteria based on the relationship obtained with crop growth rate, relative growth rate, net assimilation rate and induced nitrate reductase activity in the seedlings of three coconut hybrids namely, Malayan Yellow Dwarf (MYD) x West Coast Tall (WCT), Chowghat Orange Dwarf (COD) x WCT and Malayan Orange Dwarf (MOD) x WCT. The growth attributes as well as induced NR activity were found to be higher in MYD x WCT than the other two hybrid crosses. Being a perennial crop, the coconut has to withstand the changes in agroclimatic conditions throughout the growth period. Whether the advantages expressed during the nursery stage is maintained at later stages of growth in the above three hybrid combinations was investigated through various physiological and biochemical processess.

MATERIALS AND METHODS

Fourteen seedlings each of MOD x WCT, MYD x WCT and COD x WCT were planted in 1985 at a spacing of 7.5 m x 7.5 m and were maintained with the normal cultural practices and application of recommended doses of fertilizers. Five plants of each hybrid were selected for the present investigation. Total number of leaves produced per year were counted. Leaf area was measured by using the electronic leaf area meter (LI-COR - 3000). Dry weights of the six leaf lets were determined and the total leaf, dry weights were computed using the formula developed.

The contents of chlorophyll and sugars were estimated as per the procedure of Arnon (1949) and Dubois et al (1956) respectively. Free amino acids and protein were estimated according to Ya pin Lee and Takahashi(1966) and Lowry et al (1951) respectively. Respiration rate was measured by manometric technique (Umbreit, Burris and Stauffer, 1972). Induced nitrate reductase activity (NR), Acid Phosphate (APH) and Glutamic –Oxalacetic Transaminase (GOT) activities were measured as per the procedures of Shivasanker and Ramadasan (1983); Linhardt and Walter (1963) and Bergmeyer (1963) respectively. For all the estimations sixth leaf with two replications were taken during May 1987.

RESULTS

In general, MYD x WCT exhibited higher growth rates than the other two hybrids (Table I). Higher rate of leaf production, with lower leaf senescence rate was observed in MYD x WCT, whereas MOD x WCT had lower rates of leaf production and higher leaf senescence rate. The increase in leaf area ranged from 41 and 25% and leaf dry matter production 26 and 17% in MYD x WCT and COD x WCT respectively in comparison with MOD x WCT. A similar increase in height and girth was also observed.

Of all the three hybrids, COD x WCT had higher sugar content and lower respiration rate. However, the free aminoacid and protein contents were found to be lower (17% and 68%) in COD x WCT when compared with MOD x WCT. MOD x WCT had lower chlorophyll and sugar contents. This hybrid had higher free aminoacid and protein contents than the other two hybrids. (Table II)

Induced NR activity and MDH were found to be 61% higher in MYD x WCT than in MOD x WCT. The percentage increase in degradative enzymes *i.e.*, APH and GOT was 143% and 162% respectively for COD x WCT as compared to MOD x WCT; the increase was less marked in MYD x WCT (Table III).

Table I. *Growth attributes of hybrid seedlings*

Parameter	MOD x WCT	MYD x WCT	COD x WCT
Rate of leaf production	5.70	7.86	6.20
Rate of leaf senescence	3.40	2.10	3.50
Leaf area $cm^2 \times 10^3$	31.27	44.32	39.00
Leaf dry weight $\times 10^3$	163.5	206.15	191.50
Total height (m)	1.34	1.56	1.45
Girth (cm)	32.75	38.00	38.00

Table II. *Biochemical constituents of hybrid seedlings*

Constituents	MOD x WCT	MYD x WCT	COD x WCT
Chlorophyll $mg.g.fr.wt^{-1}$	4.85	5.55	5.19
Total soluble sugars $mg.g.fr.wt^{-1}$	7.38	9.82	13.49
Free aminoacids ,,	35.62	32.50	29.70
Protein ,,	2.50	2.05	0.81
Respiration $\mu l.O_2$ consumed $hr^{-1}.dm^{-3}$	743	633	554

Table III. *Enzyme activities of hybrid seedlings*

Enzyme	MOD x WCT	MYD x WCT	COD x WCT
Induced NR activity Nanomoles	22.5	36.2	33.0
Malate dehydrogenase	0.375	0.447	0.332
Acid phosphatase mg. prot. hr^{-1}	49.5	60.1	120.6
GOT μg. h^{-1} mg. $prot^{-1}$	5.13	6.12	13.50

DISCUSSION

Plant growth is controlled by the interaction of hereditary and environmental factors operating through a complex of internal processess. The maintainance of higher leaf number with lower rates of leaf senescence associated with favourable biochemical mechanisms results in higher photosynthetic rates which contribute towards growth and consequently yield, (Kriedmann, Kliewer and Harris, 1970; Kinerson 1975). The metabolic processess involved in synthesis are found to be higher in MYD x WCT. Induced NR activity and free aminoacids contribute to higher amounts of protein. The sugar content and respiration in MYD x WCT can be correlated with the processes involved towards anabolism which is reflected on growth attributes. The present data is in agreement with earlier report in which Shivashanker and Kasturi bai (1988) had shown higher growth rate and induced NR in MYD x WCT. In other words MYD x WCT is able to maintain its seedling vigour from nursery through vegetative phase.

During seedling stage in the nursery MOD x WCT had higher growth rate than COD x WCT while under field conditions COD x WCT surpassed MOD x WCT in growth. This behavioural difference perhaps, could be due to a slower growth rate in the nursery or rapid acclimatization to field which results in a steep growth curve rather than a smooth sigmoidal curve reported in many species. Interestingly, COD x WCT exhibited higher activities of degradative enzymes such as APH and GOT with low protein content. These enzymes increased with age and in senescent tissues (Wollgiehn 1967; and Kramer and Kozlowski 1979).

It is evident that the superiority expressed by MYD x WCT at the nursery stage is still being maintained through vegetative phase. Whether this will be carried through the preflowering and reproductive phases have to be monitored before arriving at the predictive value of seedling characters in their yield potential.

REFERENCES

ARNON, D. I. 1949. Copper enzymes in isolated chloroplasts. Polyphenol oxidase activity in *Beta vulgaris*. *Pl. Physiol.* **24** : 1.

BERGMEYER, H. U. 1963. Colorimetric estimation of glutamic transaminase. In *Methods in Enzymology* (Ed.) H. U. Bergmeyer, Verlag Chemie GmBh Weinhein p. 779.

DUBOIS, M., GILLES, K. A. HAMILTON, J. K., REBERS, P. A., and SMITH, F. 1956. The phenol sulfuric acid reaction for carbohydrates. *Anal Biochem.* **28** : 350.

KIEDEMANN, P. E., KLIEWER, W. M. and HARRIS, J. M. 1970. Leaf age and photosynthesis in *Vitis vinifera*, L. *Vitis.* **9** : 97.

KINERSON, R. S. 1975. Relationship between plant surface area and respiration in lobolly pine plantations. *Oecologia* **29**: 1.

KRAMER, P. J., and KOZLOWSKI, T. T. 1979. *Physiology of Woody Plants*. Academic press, New York p. 122.

LINHARDT, K. and WALTER, K. 1963. Colorimetric estimation of acid phosphatase activity. In *Methods in Enzymology* (Ed.) H. U. Bergmeyer, Verlag Chemie GmBh, Weinhein.

LIYANAGE, D. V. 1955. Planting material for coconuts. *Ceylon. Cocon. Quarterly.* **6** : 75.

LOWRY, O. H., ROSENBERG, N. J., FAN, A. L. and RANDAL, R. J. 1951. Protein measurement with folin phenol reagent. *J. Biol. Chem.* **193** : 265.

SHIVASHANKER, S. and KASTURIBAI, K. V. 1988. A comparative study of the growth and nitrogen accumulation capacity of hybrid seedlings. *Phil. J. Coconut Studies.* XIII (1) : 24–30.

SHIVASHANKER, S. and RAMADASAN, A. 1983. Nitrate reductase activity in coconut leaves. *J. Sci. Food. Agric.* **34**: 1179.

TAN, G. Y. and HANDON, J. J. 1976. Nursery selection. In *Developments in Crop Science* 1. Oil palm research. (ed) R. H. V. Corley, J. J. Handon and B. J. Wood). Elsevier publication. Amsterdam p. 139.

UMBREIT, W. W., BURRIS, R. H. and STAUFFER, J. H. 1972. Constant volume manometry – the "Warburg" In *Manometric and Biochemical Techniques* Burgess Pub. Co. Minnesota. p. 1.

WOLLGIEHN, R. 1967. Nucleic acid and protein metabolism of excised leaves. *Symp. Soc. Exp. Biol.* **21** : 231.

YA PIN LEE and TAKAHASHI, T. 1976. An improved colorimetric determination of aminoacids with the use of ninhydrin. *Anal. Biochem.* **14** : 71.