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DIURNAL RHYTHM IN DRY MATTER ACCUMULATION AND CARBOHYDRATE CONTENTS IN THE LEAVES OF ARECANUT PALM (*ARECA CATECHU* L.)*

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ABSTRACT

Effects of diurnal rhythm in dry matter, water content and carbohydrate fractions in the leaves of arecanut (*Areca catechu* L.) were investigated. Dry matter accumulation was observed more during the day time and lesser amount in the night period. An inverse relationship between dry matter production and water content was observed. Regarding the carbohydrate synthesis, all fractions of sugars were found to be affected considerably. In general, the least amount of carbohydrate was obtained at sun rise and greatest at sun set.

INTRODUCTION

Yield of many crop plant depends on the growth processes which utilise solar energy through photosynthesis. During this process, dry matter production is accelerated directly affecting carbohydrate synthesis which is the end product of photosynthesis. A number of workers have investigated the daily variation in the dry matter and carbohydrate contents in the leaves of various crop plants (Parkin, 1912 ; Miller, 1924). Kishi and Monobe (1931) found in mulbery leaves that the total carbohydrate content was least at sun rise and greatest at sun set. Denny (1932) noted that herbaceous plants exhibited marked changes in the carbohydrate content from night until morning, while woody plants showed only slight changes during the same period. Nevertheless, adequate information on the diurnal rhythm of a perennial crop like arecanut is still lacking in the field of biological sciences. The present investigation was therefore, taken up to study the influence of light and dark periods on the contents of dry matter, water and carbohydrate fractions and their changes during the 24 hours of the day.

MATERIALS AND METHODS

Four areca palms (*Areca catechu* L.) of uniform growth productivity and growing under identical soil and cultural practices in the field of the institute were selected. A composit sample of 1st, 3rd 5th and 6th leaves from the shoot apex were taken for analysis at 3 a.m., 6 a.m., 9 a.m., 12 Noon, 3 p.m., 6 p.m., 9 p.m., and 12 mid-night and the light intensity on leaves was measured using a photometer during the day time being 180, 480, 1400, 1850 and 310 foot candles respectively. Dry matter and water content were determined in the leaves employing the method of A.O.A.C. (1960). Reducing and total sugars were estimated from alcoholic extraction according to the method described by Heinze and Murneek (1940). The amount of non-reducing sugar was known by substracting the reducing sugars from total sugars and multiplying the same by factor 0.95. The starch was estimated from the dried residue of alcohol insoluble solids (AIS) in terms

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TABLE 1

Diurnal Changes in Dry matter, Water and Carbohydrate Contents in the leaves of arecanut (*Areca catechu* Linn) ; Mean of 4 replicates

Period	Field temp °C	Percentage of constituents: Dry matter Trans. formed (θ=Sin)	Dry matter $\frac{-1}{\sqrt{P}}$	Water content Trans-formed (θ=Sin)	Water content $\frac{-1}{\sqrt{P}}$	Reducing Trans-formed (θ=Sin)	Reducing $\frac{-1}{\sqrt{P}}$	Non-reducing Trans-formed (θ=Sin)	Non-reducing $\frac{-1}{\sqrt{P}}$	Total sugar Trans-formed (θ=Sin)	Total sugar $\frac{-1}{\sqrt{P}}$	Starch Trans-formed (θ=Sin)	Starch $\frac{-1}{\sqrt{P}}$
6 A.M.	23	31.485	27.30	58.515	72.75	9.587	2.75	5.645	0.97	11.247	3.80	11.732	4.15
9 A.M.	27	32.202	28.40	57.827	71.65	9.935	2.95	5.770	1.05	11.615	4.05	12.185	4.45
12 Noon	32	33.052	29.75	56.947	70.25	10.130	3.10	6.125	1.15	11.987	4.30	12.685	4.80
3 P.M.	36	33.555	30.60	56.445	69.45	10.165	3.11	6.745	1.38	12.395	4 60	12.897	4.95
6 P.M.	26	32.850	29.45	57.150	70.60	10.292	3.18	6.690	1.35	12.472	4.65	13.005	5.10
9 P.M.	25	32.092	28.20	57.925	71.80	10.210	3.15	5.317	0.86	11.692	4.10	12.317	4.55
12 Mid-night	24	31.402	27.15	58.597	72.85	9.975	3.00	4.402	0.59	11.022	3.65	11.517	3.95
3 A.M.	22	30.882	26.35	59.117	73.65	9.925	2.95	3.832	0.45	10.800	3.50	11.205	3.80
C. D. (P=0.05)		0.3319		0.3410		NS		1.1773		0.5247		0.3616	
C. D. (P=0.01)		0.4498		0.4621		NS		1.5954		7.7110		0.4900	

Note : P=Proportion

θ=Angle of equal information corresponding to proportion

of glucose after acid hydrolysis with takadiastase enzyme (Heinze and Murneek, 1940). The figures thus obtained were multiplied by 0.90 to get the amount of starch present (A.O.A.C., 1960). Statistical calculations were carried out by transforming the figure in transformed value as suggested by Pearce (1965).

Results and Discussion

Data on diurnal changes in dry matter, water and carbohydrate contents as observed in the leaves of arecanut palms are presented in table 1. Dry matter began to increase between 6 a.m. and 9 a.m., reached a maximum at 3 p.m. and decreased gradually from that time until day light the following morning. In the case of water content an inverse trend was recorded. Similar results were also noted by Miller (1917) in the leaves of corn and sorghum.

Changes occurring in carbohydrate contents showed that the total sugars in the leaves begin to increase between 3 and 6 a.m., reaches a maximum at 6 p.m. and decreased gradually thereafter. The reducing sugars showed very little increase and the amount present at different periods of the day was very similar to total sugars. The non-reducing sugars increased markedly during the day and decreased during the night. All the constituents excepting reducing sugars are statistically significant for different intervals of sampling.

On the other hand, there was a gradual increase in starch content from early morning till evening, which could be due to photosynthesis, while a rapid fall from mid night to early morning with a corresponding increase in the sugars was probably the results of starch conversion due to hydrolysis. Similar types of results were also reported by Miller (1924), Thomas and Hill (1937) and Sreeramulu *et al.* (1970) in the leaves of corn, sorghum, alfalfa, wheat and ground nut respectively.

From the close agreement between changes of carbohydrate fractions, dry matter accumulation and water content during the day, it is evident that the effect of light on dry matter accumulation seems to be through carbohydrate metabolism.

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*Original not seen.