CHANGES IN LEAF CARBOHYDRATES IN RELATION TO COMMENCEMENT OF FLOWERING IN COCONUT PALM

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ABSTRACT

Changes in leaf carbohydrates were monitored in a group of young palms for a duration of three years during which period six of them commenced flowering. The changes in carbohydrate fractions, as influenced by the environmental factors, in the palms that commenced flowering, during the period under study are discussed.

INTRODUCTION

The role of carbohydrates in the flowering of plants was first elaborated by Klebs (1918). Since then, the subject had received greater attention, and it is now known that in several plants, the flowering process is preceded or accompanied by increase in soluble carbohydrates. In several fruit trees, including coconut palm, a high carbohydrate reserve has been reported as pre-requisite for commencement of flowering (Ogaki and Fuzita 1963; Ramadasan and Mathew, 1977).

In coconut, commencement of flowering is the appearance of first inflorescence in a leaf axil, generally around the age of five years, although the initiation of inflorescence primordium is reported to occur in the 10th to 14th leaf axil (Pillai *et al.*, 1972).

A study on the seasonal changes in leaf carbohydrates in a group of young palms, which had commenced flowering was carried out from January 1975 to December 1977.

MATERIAL AND METHODS

Six five-year old palms, two each belonging to T×D and D×T hybrids and West Coast Tall growing under rainfed con-

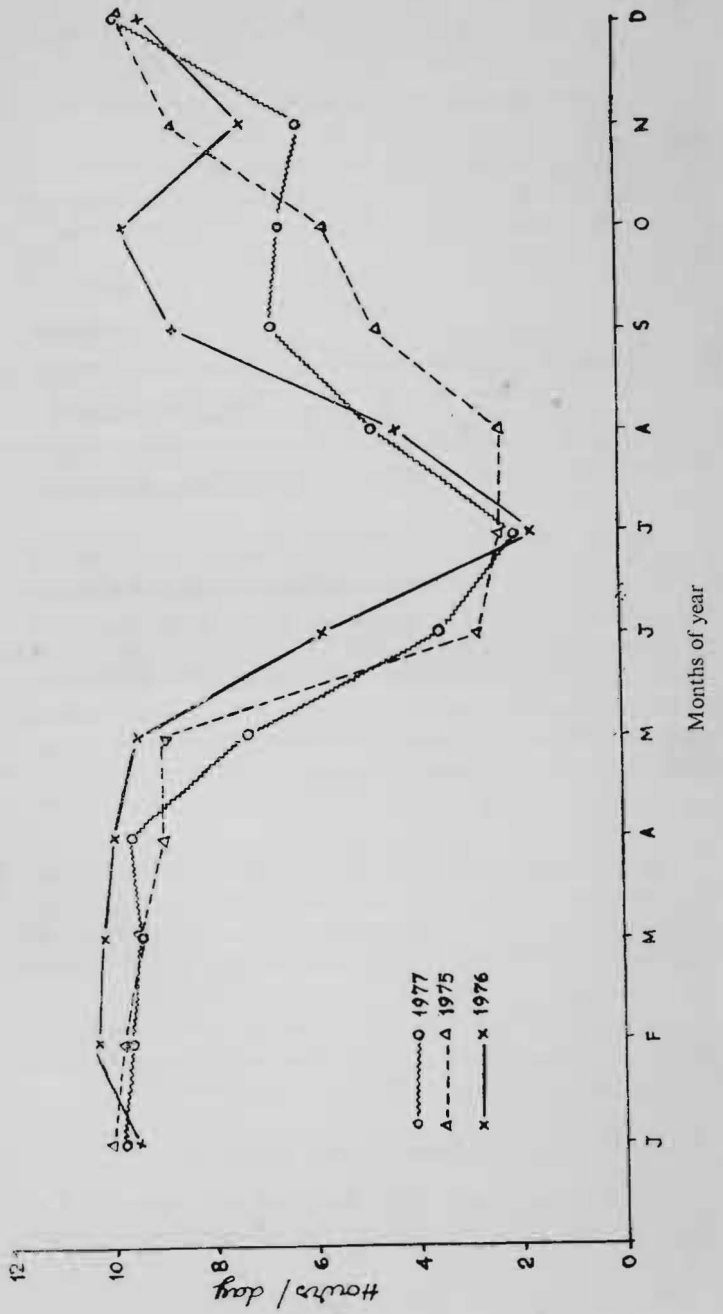


Fig. 1. Total sunshine hours

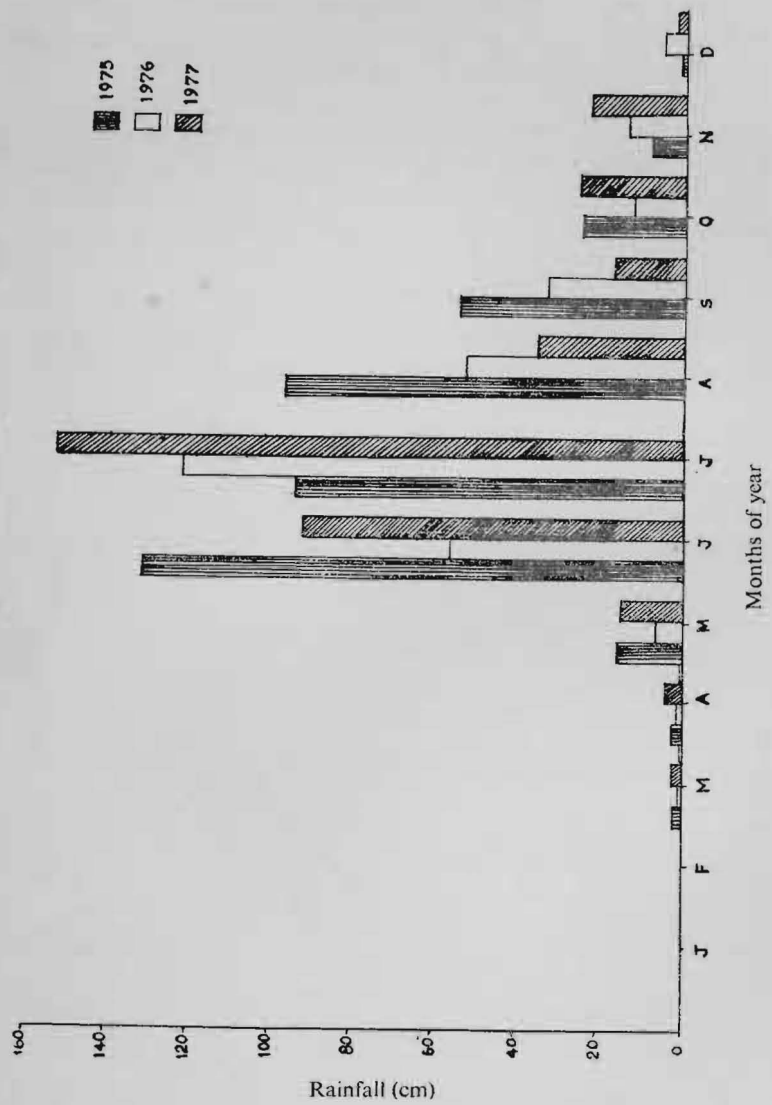


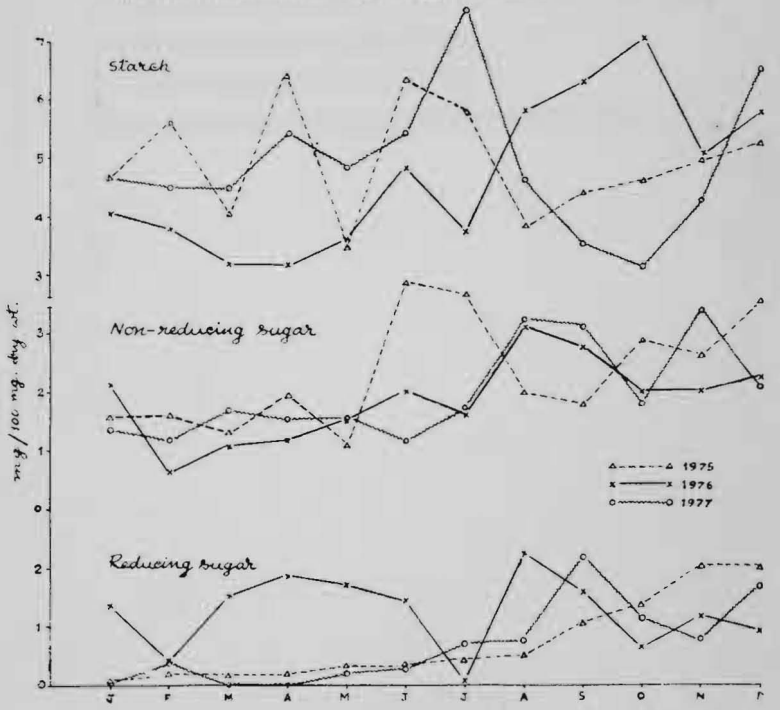
Fig. 2. Total rainfall

dition were taken for the study. Two leaflets from the middle portion of the youngest fully opened frond were collected every month and dried quickly. The finely powdered samples were analysed for starch and sugar contents for three years (1975 to 1977). Alcohol soluble sugars were extracted according to the method of Highkin and Frankel (1962) and estimated by the method of Somogyi (1952). The alcohol insoluble residue was taken for starch analysis by hydrolysing with 52% $HClO_4$ and estimated by the method of Somogyi (1952). Data on total sunshine hours and rainfall recorded during the period of study are presented in Fig. 1 & 2.

Results and Discussion

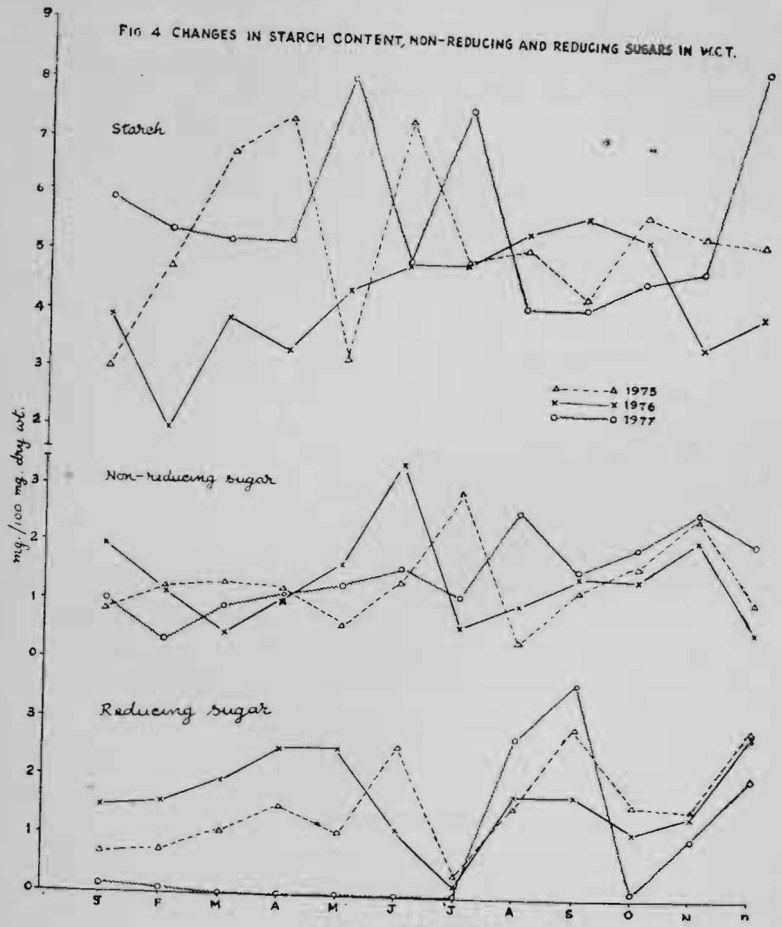
The trend in changes and the concentration did not vary much between the two palms of the same group. Hence data on the

FIG 3 CHANGES IN STARCH CONTENT, NON-REDUCING AND REDUCING SUGARS IN DxT.



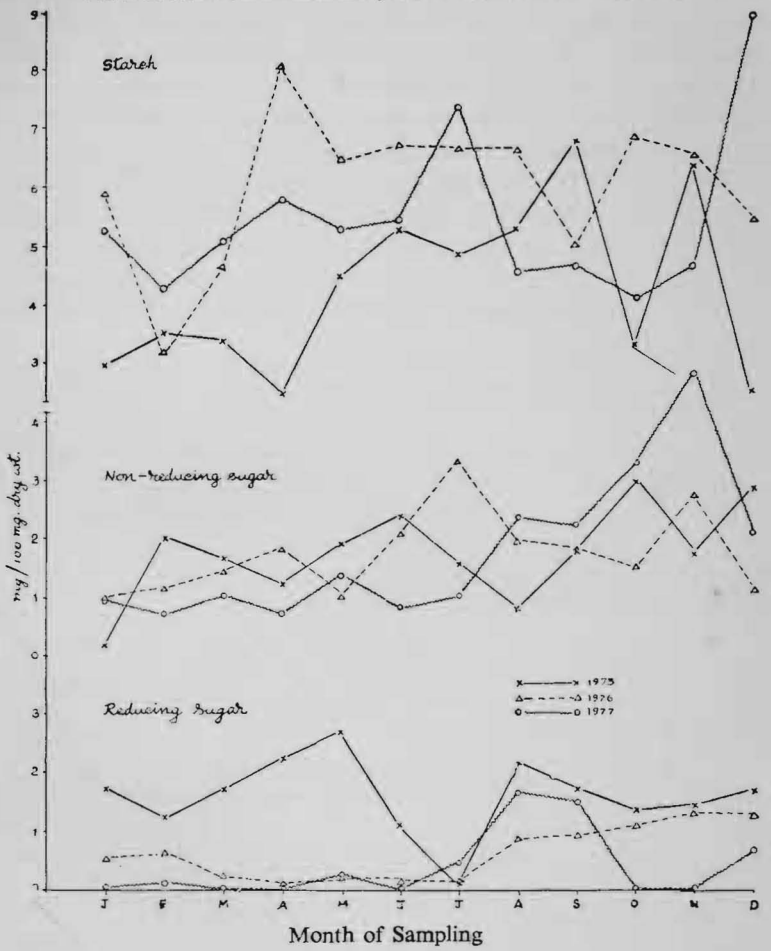
Month of Sampling

FIG 4 CHANGES IN STARCH CONTENT, NON-REDUCING AND REDUCING SUGARS IN WCT.



Month of Sampling

FIG. 5. CHANGES IN STARCH CONTENT, NON-REDUCING AND REDUCING SUGARS IN T×D



changes in the carbohydrate fraction for one palm in each of T×D D×T and WCT for 1975, 1976 and 1977 are presented in Figures 3 to 5.

Starch

In 1975 the starch content showed great variation between the months from January to July in the hybrids as well as WCT. The highest concentration, however, was recorded between March

and April in all the palms studied. In 1976 the starch content increased steadily between April and June. The concentration however, varied from 2 to 4% between January and April in all these palms. In 1977 the concentration showed a steady increase from January to July in all palms (6 to 8%). Between July and December the concentration showed the same trend in all the palms, recording lower values between August to November, while in 1975 and 1976 the starch content recorded higher values ranging from 3 to 5% during the same period. The decrease in concentration between July and November 1977 in all the palms studied compared to the higher concentration during the previous period is noteworthy. Such difference was noted in the month of December also.

Non-reducing sugar

The non-reducing sugar fraction showed the same trend of changes between January and July in all the three years. However, during 1976 and 1977 the content of this fraction ranged from 0.5% to 1.5% during January to July as against a higher concentration in 1975 (1.0 to 3.5%). While 1975 samples showed 1.0 to 1.5% concentration in August–September there is a slight increase in the concentration in 1976 and 1977 (1.5 to 3.0%). An increasing trend in this fraction of sugar between 1975 and 1977 during this period is of interest. While the concentration increased slightly between September and November, the increase was more during 1976 than that in 1975. By December the non-reducing sugar fraction recorded lower values in all the palms, in all the years.

Reducing sugar

The concentration of reducing sugar ranged from 0.1 to 0.5% between January and August in 1975 followed by an increase in September in T×D and D×T hybrids. In WCT, the concentration was higher (2 to 3%) during this period than that in the hybrids (1 to 2%). In 1976, the values recorded were higher (1.5 to 2.5%) during January to May in both the hybrids as well as WCT, where as in 1977 the concentration was drastically reduced, (0 to 0.2%) during this period. Beyond July, in the hybrids as well as WCT there was a sharp increase in the concentration, reaching a peak of 2.5 to 3.5% by September. A sudden decrease, thereafter, in

October in all the years in all the palms is of interest. This decrease from September to October was more drastic in 1977 than in other years. A further increase was recorded from November to December in all the palms during 1975, 1976 and 1977.

In coconut, it has been reported that the inflorsecence takes about 26 months to emerge out of the leaf axil (Patel 1938). Livermann and Bonner (1953) observed that successful flower initiation in herbaceous plants depend upon the operation of endogenous growth regulators requiring the presence of adequate carbohydrate resources. Hence the possible role of endogenous growth regulators in the initiation of inflorescence is a subject for detailed study. The present results indicate the necessity of adequate carbohydrate resources for the active development of the inflorescence which was spread over a period of 26 months after initiation.

Kasturi Bai and Ramadasan (1976) reported an accumulation of mostly insoluble and less soluble fractions of carbohydrates during the period when the sunshine hours per day average 8 to 9 hours with no rainfall, as against a highly soluble fraction during the period when sunshine hours averaged 2 to 3 hours with adequate rainfall.

The six young palms used for the present study commenced flowering during the month of October 1977. Presumably these infloresences had been initiated during the months of August/ September of 1975.

The data on the duration of sunshine hours and rainfall showed that the trend was the same during the three years. The sunshine hours average 8 to 10 during the summer months, followed by a sharp drop during rainy season in June to August with a consequent increase from 6 to 9 hours, thereafter. The mean temperature did not show much variation during the three years of study. Except the variability in the concentration of the carbohydrate fractions in the young palms between the years and between the hybrids and WCT, the changes in the carbohydrate fractions also followed broadly the same trend. However, the variations observed in the concentration, especially the sugar fractions between the years 1975 to 1977 are of interest.

The results showed that while the starch content increased when the sunshine hours were high, the soluble fractions predominated when the precipitation was high. The starch content recorded a decrease from August to November in 1977 as against an increase in the fraction of the non-reducing sugar during this period. The increase in concentration of non-reducing fraction during this period in 1977 coincided with the period of commencement of flowering.

The changes in the reducing sugars were of particular importance in this regard. During 1977 the reducing sugar fraction recorded very low values upto July as compared to the concentration in 1975 and 1976. During the subsequent period, while there was a sharp decrease in the reducing sugar fraction after September in 1975 and 1976, this decrease was more drastic in 1977. It may be noted that this highly reduced concentration of reducing fraction during October, coincided with the commencement of flowering.

The changes in the carbohydrate fractions during January to December followed the same cycle year after year. Thus, presumably, the different stages in the development and growth of inflorescence also passed through these cycles as influenced by the environmental factors. The results of the present study would indicate, that the period from August to December when the sunshine hours as well as precipitation are adequate is the critical period in the commencement of flowering, since only during this period maximum mobilization of carbohydrates in the form of soluble fraction was found to occur.

Patel (1938), after dissection of the growth points of several young palms, recorded that about 75% of the total growth in length of the inflorescence occurred during the period about 6 months before the opening of the spathe. The present study, thus, indicate that increased availability of soluble carbohydrate fraction is a pre-requisite for the development and continued growth of the inflorescence. The requirement of increased soluble sugars in the bud during transition from vegetative to reproductive phase in herbaceous plants had been reported (Bodson, 1977, Fontes and Ozbun, 1972). This situation is assured only during the period after July in coconut. Under rainfed conditions the

increased availability of adequate soluble carbohydrate fraction is restricted to this season. The increased productivity of the palm under irrigation may not be only due to the increased availability of nutrients made available as a result of higher moisture levels in the soil, but also due to the assured availability of soluble carbohydrate fractions for the initiation and development of inflorescence.

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