

EFFECT OF WEATHER FACTORS ON COCONUT AND COPRA PRODUCTION IN KERALA, INDIA

(Effect of seasonal factors on nut characteristics of West Coast Tall Coconut Palm)

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ABSTRACT

Studies made on the constituents of the coconut fruits harvested from West Coast Tall coconut palms grown under rainfed conditions during the different seasons of the year identified as hot weather season from March to May, southwest monsoon season from June to August, North east monsoon season from September to November and cold weather season from December to February in Kerala, India have indicated that the fruits harvested during the hot weather season are smaller in size but more in number than those harvested during the other seasons of the year. They have low husk content but more kernel content resulting in more copra content per nut. Shell content also is high in these nuts. In the case of fruits harvested during other seasons of the year the number of nuts obtained is low. They are larger in size and have more husk content but less kernel and copra content per nut. The nut characteristics are very much influenced by the weather conditions prevailing during the twelve month period of development from the fertilized flower to the mature nut. The studies also show that the effects of the season are not operating in the same way or to the same extent on the different constituents of the fruit like husk, kernel, shell and copra. This is evident from the variation in the constituents of the fruit. The data indicate that maximum output of kernel, shell and copra are obtained from the palms during the hot weather season.

INTRODUCTION

The yield of nuts of coconut palms grown under rainfed conditions is influenced by weather factors like rainfall, day-length, temperature, humidity, etc. which result in significant seasonal variations in yield of nuts and yield attributes. These variations arise due to cyclic influence of varying seasons on the different critical stages during the initiation and development of the inflorescences and female flowers and maturity of the nut. This pattern of production is seen to persist year after year with minor variations. The effect of seasonal factors on coconut yield of nuts and yield attributes of West Coast Tall coconut palms grown under rainfed conditions in Kerala, India was studied and discussed in earlier publication (Satyabalan 1994). The seasonal effects of the constituents of the fruit during the period of development from a fertilized flower to a mature nut has not been studied in detail. Such a study involves the study of the nut constituents of all fruits of each bunch of the palms harvested during the different seasons of the year. An attempt has been made to study the changes in the constituents of the fruits of West Coast Tall coconut palms harvested every month during the year under study in Kerala and the observations reported in this paper.

The climate and the different seasons in Kerala

The climate is tropical and the different seasons of the year have been identified as the following four seasons. The weather factors like rainfall, temperature, humidity and sunshine during the four seasons in Kerala during the period of 20 years have been summarised and presented in Table 1. The four seasons are 1) hot weather season during the months of March to May 2)

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southwest monsoon season during the months of June to August 3) northeast monsoon season during the months of September to November and 4) cold weather season during December to February. The data indicate that during the hot weather season the day length is of longer duration, the temperature is high, the humidity is low with occasional summer showers. During the southwest monsoon season, the daylength is of short duration, the temperature is low with high humidity. Since it is the monsoon season, the rainfall is very high. During the northeast monsoon season, the daylength is short, the temperature is low and the humidity is high. Since this period also is a monsoon season there is occasionally some rain. During the cold weather season there is no rain. The minimum temperature is low and the humidity is also low. But the day length is long.

The constituents of the fruit of the coconut palm and the effect of climatic factors on them during the different states of development from a fertilized flower to the mature nut.

The fruit of the coconut palm is botanically known as a fibrous drupe and popularly the nut. A fully matured coconut fruit has mainly four parts namely the smooth outer skin or epicarp which with the exocarp forms the fibrous mesocarp which is the husk portion, the hard endocarp which is the shell portion, the endosperm or the meat or kernel and the water inside the nut which is the liquid endosperm. The development of the fertilized flower into a mature nut takes about 11 to 12 months. During this period the constituents of the fruit are affected due to the influence of the seasonal factors which operate during the different stages of development of the fruit. Earlier workers have described the different stages of development from a fertilized flower into a mature fruit in coconut in Kerala (Sampson 1923, John 1953). John (1953) has described the growth and development of the fruit in Kerala in the following stages:

- 1) Button stage - during the first month after fertilization and the fertilized flower is known as the button.
- 2) Immature nut - when it is 2 to 4 months after fertilization. There is rapid growth in tissues. A cavity develops for subsequent accommodation of water, meat and shell. During the development a small quantity of water is formed.
- 3) Tender nut- when it is 5 to 8 months after fertilization. Size increases, meat is formed, volume of water increases and the water is sweet and suitable as a tender coconut drink. Differentiation of fibre is noticed.
- 4) Mature nut - when it is 8 to 12 months after fertilization. The growth of the nut is slow and there is slow process of desiccation. Water decreases and there is an increase in the weight of the kernel. Embryo is formed. During the period of development the fruit characters change during the four seasons.

Patel (1938) had reported that the nuts harvested during the different months in a year differ in their nut and copra characters. Krishna Marar and Pandalai (1957) had also observed marked differences in the development of nuts that are harvested in fully ripe condition in the different seasons of the year. Vijayalakshmi, Divakaran Pillai and Krishna Marar (1962) reported that the effect of season is not operating to the same extent on the different constituents of the nut. According to Abeywardena (1958) every bunch of coconut comes under the influence of 12 months weather cycle and the final yield as also the quality of nuts will bear the imprint of the cumulative effect of this impact. Although each bunch of nuts is influenced by a 12 month weather cycle, the actual conditions encountered by the nuts on the different bunches at similar stages of their development will be quite different. Coomans; (1975) has stated that the available water, temperature and sunshine have an influence on seasonal fluctuations in coconut yield. Their action intervenes at various moments in the development of inflorescence and the fruit.

Seasonal effects on the fruit and nut constituents of those harvested from the same West Coast Tall coconut palms during the four seasons of the year

In order to study the effect of the four seasons of the year on the constituents of the coconut fruit, well matured Tall coconut palms growing in a well maintained garden receiving similar treatments and growing under rainfed conditions; were collected and studied for their different characteristics. The bunches were harvested after a period of 12 months from the date of the opening of the inflorescences. The nut and copra characteristics like the weight of fruit, weight of husk, weight of husked nut, weight of kernel, weight of shell and weight of copra of each nut of individual bunch of each palm were recorded every month. The nuts studied were uniformly ripe and the copra dried to constant weight. The total number of nuts obtained from the ten palms during the year of study was 708, the number varying from a minimum of 32 nuts in November to a maximum of 86 nuts in February. In each palm the total number of nuts studied varied from 54 to 86. Out of 708 nuts harvested during the year, 62 nuts were studied in January, 86 nuts in February, 78 in March, 85 in April, 56 in May, 63 in June, 45 in July, 67 in August, 41 in September, 48 in October, 32 in November and 42 in December, respectively.

The mean values of the weights of the nut constituents and of the copra obtained from the nuts harvested every month from the same ten palms during the year are summarized for different seasons and presented in Table 2. The main constituents of the fruit are the husk content and the husked nut and the constituents of the husked nut are the kernel, the shell and the nut water contained in the nut. The kernel which is the most important constituent of the nut, on drying becomes the copra. In the Table are presented the mean values and the range of the weight of fruit, weight of husk, weight of husked nut, weight of kernel, weight of shell and the weight of copra after drying the kernel of the fruits harvested from the same palms during the four seasons of the year. The data indicate that the fruits harvested during the hot weather season of the year were found to be superior in all respects. They have less husk content but more kernel and shell content. The copra content also is high in the fruits harvested during the hot weather season March to May. In the case of fruits harvested during other seasons the husk content in the fruits is high. The nuts have less kernel which results in poor copra content per nut. For the comparison of the effects of the season on the nut constituents of the fruits harvested during the four seasons of the year they compared with those of the general mean of the total 708 fruits harvested from the same 10 palms during the twelve month period covering all seasons of the year. The data presented in Table 3 indicate the superiority of the fruits harvested during the hot weather season March to May in the year. More nuts are obtained from the palms during this season. The fruits obtained from the palms during the other seasons of the year are less in number. But the size of the fruits is large but they have more husk content. In the fruits obtained during the Northeast monsoon season the data indicate that the weight of husked nut is more than the general mean but that increase is due to increase in the shell content. It is during the hot weather period that the fertilized flowers, the fruits of which are harvested during the hot weather season, develop, which indicated that high temperature, long hours of sunshine, low humidity and summer showers received during the season contribute to their all round development. The variation noticed in the nut and copra characters of the fruits can only be attributed to the effect of climatic factors prevailing at the time of development of the nuts. It is evident that the effect of the season is not operating in the same way or to the same extent on the different constituents. It is difficult to ascribe or attribute the effect to any specific or particular climatic factor or factors during the different stages of development. It is not possible to explain the seasonal differences in terms of individual weather factors. In Table 4 are presented the data on the total output of husk, kernel, shell and copra of the fruits harvested from the ten palms during the different seasons of the year under study. The data indicate that maximum output of kernel, shell and copra are obtained from the fruits of the hot weather season since more nuts are produced and the nut has more kernel, shell and copra content than those of other seasons.

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Table 1-Climate parameters for the four season of the year in Kerala, India*

Season	Rainfall		Temperature		Relative Humidity	Sunshine (hr/day)
	Total quantity	No. of rainy days	Max.	Min.		
Hot weather season (Mar-May)	328.6	12.4	32.7	24.5	84.7	8.7
South-West Monsoon (June-Aug)	2708.1	71.9	28.9	23.0	93.7	3.4
Northeast Monsoon (Sept-Nov)	589.9	26.3	30.5	22.5	91.0	6.9
Cold weather season (Dec-Feb)	20.1	1.7	32.1	20.8	85.0	9.1

*Mean of 20 years

Table 2-Weight of constituents of coconut fruits harvested from the same ten West Coast Tall palms during the four season of the year under study

Seasons & No of nuts studies	Wt of fruit (g)	Wt of husk (g)	Wt of husked nut (g)	Wt of kernel (g)	Wt of Shell (g)	Wt of Copra (g)
Hot weather season (Mar-May)	1103.8	502.7	601.1	310.8	161.6	180.6
Mean of 219 nuts & range	(901.4-1269.7)	(381.9-604.5)	(519.5-665.2)	(288.8-333.8)	(149.5-173.3)	(171.3-190.5)
Southwest Monsoon season (June-Aug)	1321.7	741.7	580.0	291.3	154.7	167.5
Mean of 178 nuts & range	(1179.4-1512.9)	(615.6-885.5)	(548.9-627.6)	(276.1-319.3)	(149.5-159.8)	(154.6-181.2)
North East Monsoon season (Sept.-Nov.)	1302.7	710.1	592.6	298.6	166.6	174.0
Mean of 121 nuts and range	(1081.5-1514.)	(519.3-897.8)	(562.2-627.1)	(197.4-299.6)	(162.3-171.7)	(167.4-180.1)
Cold weather season (Dec.-Feb.)	1348.7	785.0	592.7	295.7	158.2	172.9
Mean of 190 nuts and range	(1261.4-1410.3)	(673.5-869.2)	(543.1-587.9)	(289.6-299.5)	(150.6-168.1)	(168.7-178.9)
Mean of 708 nuts	1262.2	680.0	582.2	300.3	159.0	173.5

Table 3
Comparison of mean weights of fruit components of different seasons with
Those of the general mean of all the nuts of all seasons

Seasons & No of nuts studies	Wt of fruit (g)	Wt of husk (g)	Wt of husked nut (g)	Wt of kernel (g)	Wt of Shell (g)	Wt of Copra (g)	Mean
Hot weather season (Mar-May)	1,103.8	502.3	601.1	310.8	161.6	183.6	219
General mean	1,262.2	680.0	582.2	300.3	159.0	173.5	708
	-158.4	-177.3	+18.9	+10.5	+2.6	+10.1	
Southwest Monsoon season (June-Aug)	1,321.7	741.7	580.0	291.3	154.7	167.5	178.n
General mean	1,262.2	680.0	582.2	300.3	159.0	173.5	708
	+59.5	+61.7	-2.2	-9.0	-4.3	-6.0	
North East Monsoon season (Sept.-Nov.)	1,302.7	710.1	592.6	298.6	166.6	174.0	121n
General mean	1,262.2	680.0	582.2	300.00	159.0	173.5	705
	+40.5	+30.1	+10.4	-1.7	+7.6	+0.5	
Cold weather season (Dec. – Feb.)	1,348.7	786.0	562.7	295.7	158.2	172.9	190n
general mean	1,262.2	680.0	582.2	300.3	159.0	173.5	705
	+86.5	+106.0	-19.5	-4.6	-.08	-0.6	

Table 4
Total output of husk, kernel, shell and copra obtained from the ten palm
During the different seasons of the year under study

Season	Output of Husk (kg)	Output of kernel (kg)	Output of Shell (kg)	Output of Copra (kg)	No of nuts
Hot weather season (Mar-May)	11.0	68.1	35.4	40.2	219
South west Monsoon (Jun-Aug)	13.2	51.9	27.5	29.8	178
North East Monsoon season (Sep.-Nov.)	8.6	36.1	20.2	21.1	121
Cold weather season (Dec.-Feb.)	14.9	56.2	30.1	32.7	190
Total	47.7	212.3	113.2	123.8	708