VARIATIONS IN THE YIELD OF COCONUTS, AS INFLUENCED BY THE PATTERN OF RAINFALL AND DURATION OF DRYSPELL

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ABSTRACT

Study of the variations in the yield of coconuts in the West Coast of India, in relation to the pattern of rainfall and duration of dryspell revealed that the yield obtained in any year is not directly related with the total rainfall received in the same year or in the preceeding years. Summer rains were having positive correlation with the yield in the succeeding year. About 60% of the variations in the annual yield were due to the changes in the duration of dryspell in the preceeding two years.

INTRODUCTION

Weather factors are known to influence crop production, especially under rainfed conditions. In the west coast of India, coconut is grown mostly as a rainfed crop. During the past five decades, many attempts have been made in India, Sri Lanka and Malaysia, to study the relationship between weather factors and yield of coconuts (Patel and Anandan 1936, Abeywardena 1968 and 1983, Balasubramaniam 1956, Lakshmanachar 1963, Marar and Pandalai 1957, Prasada Rao 1984 and 1986, Pankajakshan Nair 1985 and Vijaya Kumar *et al* 1986). The studies have highlighted the influence of pattem of rainfall, the quantity of precipitation, usefulness of sununer rains and the harmful effects of excess rains received during monsoon period, on yield. The usefulness of relative humidity, sunshine hours, drought index, etc., in predicting the yield was also brought out by some of these studies. In tWs paper, an attempt has been made to study the fluctuations in the annual yield of coconuts, in relation to the pattern of rainfall and duration of dryspell in the preceedings two years.

MATERIALS AND METHODS

The annual yield data of 187 palms in Block E of Central Plantation Crops Research Institute, Kasaragod, located in the west coast of India, for the period 1961 to 1984 were considered in this study. The palms were about 40 - 45 years age in 1961 and were growing under rainfed condition, receiving the recommended doses of fertilizers. Weekly and monthly data on rainfall (mm) and number of rainy days (with not less than 2.5 mm rain) for the period 1958 to 1984 were coflected from the agro-meteorology Observatory of the Institute and were considered as four seasons, viz. June to August (S. W. monsoon period), September to November (N. E. monsoon period), December to February (Winter) and March to May (Summer). Pearson's coefficient of correlation were worked out between the annual yield of coconuts and the weather factors, both annual (January to December) and seasonal, considering lag periods upto three years. Usefulness of these weather variables for selected periods, in explaining the variations in the annual yield of coconuts, was also examined, using multiple regression models.

RESULTS AND DISCUSSION

At Kasaragod, the average annual rainfall is nearly 3,500 mm, spread over about 115 days. During the period under consideration it ranged from a lowest of 2,499 in 1964 to a highest of 5,703 mm in 1961. The number of rainy days varied from 90 in 1979 to 1945 in 1961 (Table I). The mean annual vield per pahn during this period was 64 nuts, the range being 50 nuts in 1965 to 79 nuts in

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1970-About 90 per cent of the total rains received in a year were confined to South-West (S. W.) and North-East (N. E.) monsoon periods extending from June to November (Table II). In summer months (March, April and May) only about 8 per cent of the total annual rainfall and 10 per cent of the rainy days were recorded. Monthly data on rainfall showed that during the three months of winter (December to February) and also in March, no rains were received. During April, about 34 mm of precipitation in two days was recorded. Early onset of the monsoon (during May end) in some of the years, has contributed to the higher share of surnmer rains. Variations over the years, as revealed by the coefficient of variation (C.V.%) was not high for either the annual or the S. W. monsoon (June to August) rains.

Linear correlations have shown that the yield of nuts obtained in any year is not related to the total rainfall or total number of rainy days in the same year or in any of the preceeding three years (Table III). Consideration of weather data for the preceeding years is of importance because the primordium of the inflorescence is formed about 32 months prior to its opening (Child 1964). Even after the spathe opens, it takes about 12 months for the female flowers to develop into fully ripe nuts. Thus the weather prevailing approximately 44 months prior to the harvesting of nuts will have influence on the nut yield. But the nature and extent of the influence of these factors may vary depending on the stage of development of the inflorescence. When the influence of seasons was considered, rains during summer was found to have favourable effect on subsequent year's yields, whereas the effect was adverse on the yield in the second year. More number of rainy days during N.E. monsoon period was also found to bring down the yield in the succeeding year.

Since the C.V. over the years for rainfall and rainy days are higher during winter and surnmer months, compared to the monsoon periods (Table II), we can presume that the variations in yield between years may probably be due to the pattem of rainfall and/or due to the intensity of dryspell during these periods. When the number of weeks with little or no rains was taken as an index for the intensity of dryspell, strong negative correlations were observed between the yield in any year and the number of weeks with = 2 rainy days or with = 50 mm rainfall in the preceding year. However, in the subsequent year the relationship was positive and high (Table III). This explains the low yields obtained in some years (1965, 1974, 1980 etc.) succeeding drought years and the bumper yields, a year later. Inclusion of the period from November to February, along with the surnmer months has not improved the correlation coefficients, probably due to the higher availabihty of soil moisture to the plants, in these months inimediately succeeding the N.E. monsoon period. The effect of low or ill-distributed rains on coconut yields was not found to persist for more than one year. Park (l934) had observed that the severe drought at Puttalam (Sri Lanka) had affected the yield of nuts for two years. Recently Prasada Rao (1986) had pointed out from Pilicode (Kerala, India) that the adverse effect of drought on monthly nut yield was seen in the eight month after the drought period and continued for 12 more months. Perhaps this duration may change depending on the severity of the drought.

The above correlation analysis has shown that, under the conditions prevailing at Kasaragod, the yield of nuts in any year is influenced substantially by the summer rains of the preceeding two years and to a lesser extent by the summer rains of the same year and that of the third year preceeding the. year of harvest. Detailed investigations are needed, using monthly data on yield and weather variables, with different lag periods, to explain the beneficial effect of summer rains on next years yield and its adverse effects, a year later. Multiple regression analysis using all these four variables showed that about 62 to 65 per cent of the variations in annual yield of coconuts are explained by these variables (Table IV), with the regression coefficients corresponding to current year's and third preceding year's data being non-significant. When the analysis was confined to the data on surnmer rains of preceding two years, there was only marginal reduction in the RI values. It is possible that the RI values would have been much higher, if the total drought period had been considered together, so that the delayed onset of monsoon in June in some of the years

will also be accounted for. In this study this could not be attempted because the analysis was based on the data for seasons alone.

The effect of drought on yield and yield components was studied for a smaH sample of 30 trees. Based on the rainfall and number of rainy days during March, April and May, 1964, 1979 and 1983 could be identified as abnormal (drought) years (Table V). The production of bunches, female flowers and setting percentage in these drought years was severelY affected, in contrast to the immediately preceding and succeeding years.

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Table l : Yield of coconuts and rainfall at Kasaragod

Year	Mean Yield	Rainfall (mm)	Rainy Days	Year	Mean Yield	Rainfall (mm)	Rainy days
1961	61.1	5,703	145	1973	63.6	2,857	111
1962	61.7	3,496	130	1974	55.8	3,550	118
1963	53.0	3,077	124	1975	73.1	4,332	138
1964	74.4	2,499	106	1976	58.2	3,052	102
1965	50.0	3,105	100	1977	63.0	3,705	123
1966	77.2	2,998	112	1978	60.0	4,655	133
1967	66.1	3,733	114	1979	60.9	3,075	90
1968	63.4	4,230	105	1980	51.2	3,035	122
1969	67.0	2,934	119	1981	68.1	3,367	117
1970	79.2	4,301	123	1982	62.0	3,214	97
1971	62.8	3,877	110	1983	72.3	3,277	113
1972	74.3	3,076	101	1984	57.6	3,243	123

Table II : Seasonal distribution of rainfall at Kasaragod (1961-1984)

	Season	Rainfall (mm)		Rainy days	
		Mean	CV%	Mean	CV%
S.W. Monsoon	(June-August)	2,612.0	17.9	74.6	7.9
N.E. Monsoon	(Sept.-Nov.)	554.1	41.9	28.5	27.3
Winter	(Dec.-Feb.)	19.6	133.3	1.1	118.5
Summer	(March-May)	291.2	72.1	11.5	57.7
Annual	(Jan.-Dec.)	3,476.9	19.8	115.7	11.3

Table III: Person's coefficient of correlation for annual yield of coconut (1961- 1984) with rainfall and number of rainy days, for different lag period

Parameters	Lag periods (in years)			
	0	1	2	3
Annual rainfall	0.037	-0.037	-0.230	0.029
Total number of rainy days	0.004	-0.095	-0.291	-0.040
Rainfall during winter	0.057	0.087	0.173	0.024
Rainfall during summer	-0.115	0.096	-0.482+	-0/036
Rainfall during s.w monsoon	0.060	-0.035	-0.039	0.008
Ranfall during n.e. monsoon	0.125	-0.181	-0.212	0.038
No, of rainy days during winter	0.029	0.044	-0.089	0.215
No, of rainy days during summer	-0.266	0.341	-0.568++	0.057
No, of rainy days during s.w. monsoon	-0.027	0.008	0.071	0.370
No, of rainy days during n.e. monsoon	0.312	-0.463+	-0.015	-0.295
Rainfall/Rainy days during November-May				
No, of weeks with 0 mm rainfall	0.270	-0.105	0.350	0.187
No, of weeks with = 25 mm rainfall	0.256	-0.304	0.488+	-0.248
No, of weeks with = 50 mm rainfall	-0.128	-0.423+	0.409+	-0.293
No, of weeks with = 75 mm rainfall	-0.018	-0.138	0.581++	-0.050
No, of weeks with = 100 mm rainfall	-0.140	0.033	0.374	0.117
No, of weeks with 0 rainy days	0.350	-0.214	0.460+	-0.169
No, of weeks with = 2 rainy days	0.154	-0.269	0.639++	-0.396
No, of weeks with = 4 rainy days	0.152	-0.072	0.543++	-0.091
No, of weeks with = 6 rainy days	0.201	0.044	0.465++	-0.108
Rainfall/Rainy days during March-May				
No, of weeks with 0 mm rainfall	0.238	-0.245	0.116	0.287
No, of weeks with = 25 mm rainfall	0.222	-0.420+	0.526++	-0.061
No, of weeks with = 50 mm rainfall	0.078	-0.509++	0.535++	-0.154
No, of weeks with = 75 mm rainfall	0.003	-0.231	0.509++	-0.061
No, of weeks with = 100 mm rainfall	-0.060	0.044	0.354	0.121
No, of weeks with 0 rainy days	0.293	-0.321	0.468+	-0.049
No, of weeks with = 2 rainy days	0.201	-0.386	0.624++	-0.232
No, of weeks with = 4 rainy days	0.141	-0.121	0.491+	-0.111
No, of weeks with = 6 rainy days	0.201	0.014	0.465+	-0.108

+ Significant at P = 0.05 ++ Significant at P = 0.01

Table IV: Multiple regression models showing the relationship between the yield of coconuts and the pattern of rainfall during summer months in the year of harvest and preceding years.

Parameters	Constant term	Regression coefts. Corresponding to Different lag periods (in years)				
		0	1	2	3	R^2
Number of weeks with = 2 rainy days during March-May	52.46	0.9509 (0.8817)	-2.3953 (0.8125)	3.887++ (0.8360)	-1.3969 (0.8653)	0.65
	48.98		-2.6086++ (0.8226)	3.9662++ (0.8461)		0.59
No. of weeks with = 50 mm rainfall during March-May	68.83	0.7815 (0.8769)	-3.7815++ (0.8016)	3.6684++ (0.7986)	-1.2851 (0.82.17)	0.67
	63.23		-3.5350++ (0.8144)	3.6569++ (0.8113)		0.62

++ Significant at P = 0.01
Figures in parenthesis denote the S.Es of regression coefficients.

Table V : Incidence of drought and its effect on yield attributes

Parameter		1964 1979 1983 (mean)	1963, 65 1978, 80 1982, 84 (mean)
Rainfall (mm) during	March-May	24	340
	June-August	2,349	2,505
	Annual	2,924	3,327
Rainy days during	March-May	2	14
	June-August	71	78
	Annual	101	119
Production of bunches during	March-May	2.12	3.16
	June-August	2.42	2.78
	Annual	9.86	10.96
Production of femal flowers during	March-May	29.3	41.8
	June-August	33.4	40.6
	Annual	133.3	144.5
Setting percentage during	March-May	36.3	45.2
	June-August	34.3	41.0
	Annual	36.9	44.0