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INFLUENCE OF WEATHER VARIABLES ON COCONUT (*COCOS NUCIFERA L.*) YIELD

1. The coconut is a member of the Palmaceae family. The specific name is *cocos nucifera* (*L*). They are classified by height as the tall variety and the dwarf variety. Tall palms require 6-10 years to begin fruiting after planting. The time taken from setting to full maturity of the fruits is about 12 months and, as inflorescence is produced every month, harvesting is done throughout the year. The palms can produce nuts continuously for 50-60 years.

Coconut is a tropical palm and comes up well under hot humid climate. A mean annual temperature of 27°C was found to be the best for optimum growth and yield (Thampan 1981). Many research works were carried out to analyse the palm's behaviour toward

TABLE 1

Correlation coefficients of weather variables with annual yield

S. No.	Variable	Seasons for first lag year				Seasons for second lag year				Seasons for third lag year			
		4	3	2	1	4	3	2	1	4	3	2	1
1	NRD	—0.22	0.39	0.42	0.15	0.4	—0.25	—0.66	0.14	—0.21	0.33	0.36	—0.34
2	PET	0.60	—0.16	—0.31	0.16	—0.5	—0.04	0.46	0.04	—0.31	—0.2	—0.12	0.41
3	SSH	0.48	—0.12	—0.05	—0.09	—0.59	—0.22	0.03	—0.27	0.13	—0.21	—0.09	0.30
4	MRH	—0.31	0.15	0.57	0.11	0.09	—0.17	—0.50	0.07	—0.05	0.12	0.50	—0.04
5	TSM	—0.37	—0.12	0.33	0.11	0.43	—0.04	—0.57	—0.06	—0.20	—0.16	0.16	—0.28
6	TRF	—0.33	—0.14	0.33	0.38	0.39	—0.03	—0.57	—0.14	—0.17	—0.19	0.17	—0.16

its surroundings. Bhaskaran and Leela (1976) stated that the influence of weather on yield is a cumulative function of seasonal conditions prevailing during the period of 44 months after primordium initiation. Coconut yield in any particular year is influenced by the 'January-April' rains for two years prior to harvest (Patel 1938). The studies of rainfall pattern using 20 years moving averages indicated that high rainfall during the monsoon (June-August) as well as the absence of post and pre-monsoon showers affect the yield of coconut adversely (Rao 1982). Venkitesan (1973) found that irrigation during hot summer months improved female flower production and arrested button shedding, resulting increased yield. In the present work dependability of the palm on weather variables is studied and a functional relationship was established between weather variables and yield of the palm in coastal sandy soils of Kasaragod (Kerala).

2. *Material and methods* — Weather data needed for the study was collected from Central Plantation Crops Research Institute, Kasaragod for the period (1967-1984). The variables other than climatological normals were computed. Potential evapotranspiration as defined by Doorenbos and Pruitt (1977) was computed by modified Penman method on weekly average basis for the above period. Moisture adequacy index, which is the ratio of actual evapotranspiration to potential evapotranspiration and soil moisture storage values were evaluated on monthly average basis by water balance computations for the region using Thornthwaite and Mathers' (1955) revised book-keeping procedure. Considering uniformity in weather conditions in an year, four seasons were defined as (1) December-February, (2) March-May, (3) June-August, and (4) September-November. Seasonal average values of weather variables were evaluated and used for the analysis. The variables considered were total rainfall (TRF) in mm, number of rainy days (NRD) with rainfall 2.5 mm or more per day, average daily maximum temperature (T_{Max}) in Celsius, average sunshine hours (SSH) per day, average evaporation (E) in mm per day, mean daily relative humidity (MRH) in percentage, total evapotranspiration (PET) in mm, average monthly moisture adequacy index (MAI) in percentage and total soil moisture (TSM) in mm.

To eliminate the influence of most of the factors other than weather variables, the annual yield data from 100 West Coast Tall variety palms in the age group of 50-55 year were collected from Central Plantation Crops Research Institute, Kasaragod, grown under rainfed condition receiving equal cultural treatments for the period 1971-1985.

The method adopted for the analysis involves two steps. In the first step, weather variables were correlated with the yield of the palms and tested for significance (at 5% level). Since the yield of coconut is influenced by the climate of the past three to four years, weather variables of three lag years (one, two and three years) with nine variables in each season were considered for correlation with each year's yield.

The second step involves multiple regression analysis. Variables with significant correlation coefficients were selected for regression analysis. A software package developed by Statistics Division of Central Plantation Crops Research Institute, Vittal was used for the above purpose.

3. *Results and discussion* — The weather variables with correlation coefficients are given in Table 1 indicating the effect of weather variables over three lag years. Results show similar trends for the variables NRD, MRH, TRF and TSM except during June-August of first and third lag years and December-February of second lag year. During these periods NRD and MRH showed positive correlations whereas TRF and TSM showed negative correlations indicating that uneven and heavy rains are not conducive to the palms.

From the correlation analysis it was found that none of the variables in the third lag year influence the yield significantly. Medium and evenly distributed rainfall during the monsoon was found to be favourable to the palm which is in agreement with the findings of Rao (1982). Occasional rains during summer (March-May) were found detrimental in the second lag year and the palms require irrigation throughout the period.

TABLE 2

Multiple regression analysis of seasonal weather variables with the annual yields

S. No.	Variable	Lag year	Season	RC	SE	t value	Constant	r^2
1	NRD	2	2	—0.25	0.48	0.52	—	—
2	SSH	2	4	—10.29	5.03	2.05	—164.93	0.73
3	PET	1	4	0.45	0.21	2.13	—	—
4	MRH	1	2	1.72	1.09	1.58	—	—

RC — Regression coefficient, SE — Standard error

This may be because of the sensitivity of the palm towards water stress as 54% of annual female flowers are formed (Bhaskaran and Leela 1976). During September-November period palms showed a negative correlation with sunshine hours. During this period the elongation of internal spathe takes place. The palms prefer a humid weather during summer of first lag year during when the majority of inflorescences open. Potential evapotranspiration during September-November was favourable indicating for a dry weather. In the multiple regression analysis four variables were found to influence the yield significantly. The linear model derived showed 73% predictability. The results of regression analysis are given in Table 2.

$$Y = 1.72\ MRH_{12} + 0.45\ PET_{14} - 10.29\ SSH_{24} - 0.25\ NRD_{22} - 164.93$$

where, Y is the average annual yield/palm. Subscripts indicate lag year and season respectively.

Coconut palms showed considerable dependency on weather variables grown under identical conditions and manurial treatments. Number of rainy days and mean relative humidity during summer, potential evapotranspiration and sunshine hours during the post monsoon period of first and second lag years were found to be significant in predicting the trend of annual yield.

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