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INFLUENCE OF WEATHER ON ARECANUT AND COCOA YIELD*

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ABSTRACT

Regression analysis of weather variables suggested that yield was influenced by relative humidity, pan evaporation and rainfall in arecanut while temperature influenced cocoa yields. In case of arecanut the regression equation explains eighty four per cent of variations in yield. The equation is not a good fit in case of cocoa for predicting yield.

INTRODUCTION

Correlations between weather variables and yield of several perennial crops like coconut (Mahesha, 1987; Prasada Rao, Nair and Abdurazak 1984; Vijayakumar et al. 1989), cocoa (Alvim, 1988; Snoeck, 1979) and tea (Satyanarayana, 1984) have been reported. The climatic factors have an effect on the yield of arecanut and cocoa. An understanding of their effects on yield can help in developing prediction models. Therefore, a study was carried out to correlate the yield of arecanut and cocoa with weather variables.

MATERIALS AND METHODS

Fortnightly weather data (temperature–maximum and minimum, relative humidity – maximum and minimum, total rainfall, sunshine hours, wind velocity, pan evaporation and number of rainy days) required for analysis were collected from the meteorological observatory of CPCRI Regional Station, Vittal for a period of 12 years (1977–1988). The mean fortnightly values are presented in Table I. The annual yield from 50 each of arecanut and cocoa were collected for the same period of 12 years. This was from the aracanut-cocoa mixed cropping trial planted in 1970 at a spacing of 2.7×2.7m for arecanut and 2.7×5.4m for cocoa.

The method adopted for analysis involves two steps: (i) the weather variables were correlated with yield, (ii) the variables with significant correlation coefficients were selected for regression analysis. In this case seven weather variables were correlated with yield for current year and one year lag period separately. The correlation coefficients

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Table I. *Climatic data–mean fortnight values for the year 1977–1989 (Vittal)*

Fort-night No.	Temperature (°C)		Relative Humidity (%)		Wind speed (km/hr)	Sun shine (hr/day)	Pan evapo-ration (mm/day)	Rain fall (m m)	No. of rainy days
	Max.	Min.	Max.	Min.					
1.	33.24	19.23	91.77	44.42	2.32	9.32	4.78	0.00	0.00
2.	33.32	19.21	92.33	42.42	2.24	9.45	4.81	0.05	0.00
3.	33.93	19.59	93.75	45.66	2.40	9.56	4.96	1.44	0.16
4.	34.52	21.16	93.22	48.80	2.93	9.74	5.19	0.00	0.00
5.	34.95	22.63	92.67	48.80	2.86	9.29	5.60	8.06	0.33
6.	35.48	23.53	92.25	51.50	3.19	9.47	5.84	3.78	0.08
7.	35.65	23.91	91.14	50.83	3.21	9.44	6.00	5.33	0.50
8.	35.63	24.10	90.50	52.75	3.43	8.91	6.30	11.74	0.91
9.	34.70	24.46	89.71	52.52	3.43	8.96	6.34	22.07	1.16
10.	34.75	24.42	90.25	53.80	3.59	8.50	6.15	46.80	2.25
11.	34.07	24.40	91.74	59.70	3.23	7.32	5.89	92.68	3.33
12.	30.26	23.28	95.37	75.83	2.82	3.13	3.89	455.53	11.16
13.	28.64	22.85	96.33	80.66	3.77	2.67	2.94	589.92	13.08
14.	28.58	22.87	96.04	80.46	3.74	3.32	3.24	468.92	11.58
15.	28.20	22.83	96.33	83.37	3.40	2.72	3.09	515.35	12.41
16.	29.09	22.72	95.96	82.21	4.10	2.76	2.91	481.72	12.75
17.	28.61	23.00	96.10	80.75	3.60	3.83	3.12	355.23	11.33
18.	29.80	22.90	94.89	76.18	2.96	4.90	3.39	142.94	7.91
19.	30.46	23.52	92.45	70.44	2.70	5.78	3.46	113.76	6.75
20.	30.35	23.09	95.21	71.89	2.45	5.63	3.56	138.30	6.50
21.	31.90	23.71	95.17	65.87	2.15	7.46	3.76	78.69	4.08
22.	32.96	22.74	94.83	60.29	2.00	7.67	4.07	72.13	3.91
23.	32.35	22.23	93.75	58.66	1.92	7.33	4.24	52.77	4.08
24.	32.97	20.86	93.50	52.77	1.87	8.55	4.43	24.23	1.33
25.	33.41	20.92	92.50	49.25	2.29	8.54	4.62	5.34	0.41
26.	32.87	19.65	90.96	47.42	2.37	8.69	4.95	3.63	0.25

obtained were tested for significance at 5% level of probability, and significant ones selected for deriving regression equations.

RESULTS AND DISCUSSION

The correlations of yield of arecanut and cocoa with different weather variables were studied and significant coefficients are given (Table II). Arecanut yield was significantly correlated with rainfall of previous year (24th fortnight), relative humidity, minimum of current year (4th fortnight), temperature maximum of current year (10th fortnight), pan evaporation of current year (14th fortnight) and rainfall of current year (18th fortnight). Correlation coefficients of number of rainy days of previous year (23rd fortnight), sunshine hours of current year (3rd fortnight), temperature maximum of current year (4th and 21st fortnight) were found significant with cocoa yield. Different weather variables have been shown to be correlated with yield of coconut in India (Prasada Rao et al., 1984; Vijayakumar et al., 1989), cocoa in Brazil (Alvim, 1988) and Ivory Coast (Snoeck, 1979).

Table II. *Correlation coefficients of arecanut and cocoa yield with weather variables*

Crop	Variable	Fortnight No.	Significant correlation coefficient
Arecanut	Rainfall	24	-0.72
	Relative humidity-Maximum	26	0.74
	Relative humidity-Minimum	4	0.77
	Temperature-Maximum	10	0.72
	Pan evaporation	14	0.64
	Rain fall	18	-0.79
Cocoa	No. of rainydays	23	0.79
	Sunshine hours	3	0.76
	Temperature-Maximum	4	0.59
	Temperature-Minimum	21	0.78

Stepwise regression analysis was carried out to eliminate non-contributing variables with respect to arecanut in the first set. As a second step two variables *viz.*, rainfall of previous year (24th fortnight) and relative humidity minimum of current year (4th fortnight) were eliminated. Then, in the third step, temperature maximum of current year (10th fortnight) was eliminated to obtain the regression equation. At the third trial, final regression equation with contributing variables for arecanut yield (weight of nuts) was obtained:

$Y = -27.301 + 0.422 \times_2 + 0.822 \times_5 - 0.02 \times_6$ ($R^2 = 0.908$); where

X_2 = RH maximum of previous year (26th fortnight)

X_5 = Pan evaporation of current year (14th fortnight)

X_6 = Rainfall of current year (18th fortnight)

From the equation it is possible to predict current year yield at the end of 18th fortnight (September). The actual and predicted yield for the years from 1977 to 1989 have shown close agreement within a statistical limit of 10%, except for the periods 1981-82, 1985-86 and 1987-88 when the deviations were 16.9%, 26.0% and 16.5% for weight of nuts respectively.

Similar step–wise regression was carried out in two sets to eliminate non–contributing variables for cocoa yield (no. of pods). Number of rainy days of previous year (23rd fortnight) and sunshine hours of current year (3rd fortnight) were eliminated. From the equation, it is seen that weather variables of the current year are affecting yield. The regression equation for cocoa yield (no. of pods) is given below :

$Y = -545.565 + 7.90 \times_3 + 10.637 \times_4$ ($R^2 = 0.759$);

Where, X_3=Temperature maximum of current year (4th fortnight)

X_4 = Temperature maximum of current year (21st fortnight).

However, the regression equation has no much of predictive value. The actual and predicted yields were anyway within 10% deviation except for 1979 and 1981 for the number of pods. Thus, the study has shown that by September, a forecast can be given for that year's arecanut yield with a good degree of precision.

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