

EFFECT OF WEATHER PARAMETERS ON ARECANUT (*ARECA CATECHU* L.) YIELD IN WEST BENGAL

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ABSTRACT

The effect of weather parameters on arecanut yield was studied using correlation analysis. The highly correlated weather parameters were used in regression analysis to predict arecanut yield. The analysis revealed that 97 percent of yield variation could be explained by minimum temperatures of April, two years earlier, and relative humidity of November and minimum temperatures of December of previous year.

INTRODUCTION

Morphological and anatomical studies of arecanut (*Areca catechu* Linn.) revealed that the crown had eight to nine opened leaves, one spindle leaf and 10 to 13 leaves and leaf primordia in varying stages of development with inflorescence primordium in every leaf axil upto the growing point (Murthy and Bavappa, 1960; Bavappa and Rao, 1970). If the mean annual leaf fall is taken as six, the 10 to 13 leaf and leaf primordia will represent a two year growth (Murthy and Bavappa, 1960). Similarly, the reproductive cycle in coconut is also very long as each bunch has to go through a long cycle of about 3½ years of development from primordial stages upto maturity (Vijayakumar *et.al.* 1989). Thus, in these crops the reproductive phase is exposed to various weather parameters and their interactions during the long period of development. This enabled scientists to work out correlations between yield of these crops and various weather parameters (Prasad Rao *et.al.* 1984; Vijayakumar, *et.al.* 1989 in coconut and Vijayakumar *et.al.* 1991 in arecanut). These correlations helped in developing regression equations for forecasting the yields of these crops.

Arecanut is also grown in North Eastern India, where the climatic conditions are different from that of Karnataka. Therefore, the present study was carried at the Central Plantation Crops Research Institute, Research Centre, Mohitnagar, to understand the relations of various weather parameters with arecanut yields.

MATERIALS AND METHODS

Monthly mean maximum and mean minimum temperatures, relative humidity and total rainfall data (Fig. 1 and 2) of CPCRI Research Centre, Mohitnagar for 15 years (1976-1990) were used for the analysis. The annual yields of 608 areca palms were collected for the corresponding period from an areca garden planted in 1967 at a spacing of 2.7 x 2.7 m. The palms received 100 g N, 40 g P₂O₅ and 140 g K₂O in addition to 10 kg Farm Yard Manure per palm. The palms were rainfed. Hand weeding was done as and when required. No pest and disease problem was noticed on these palms. Arecanut harvest is done between April and July every year.

The weather variables were correlated with

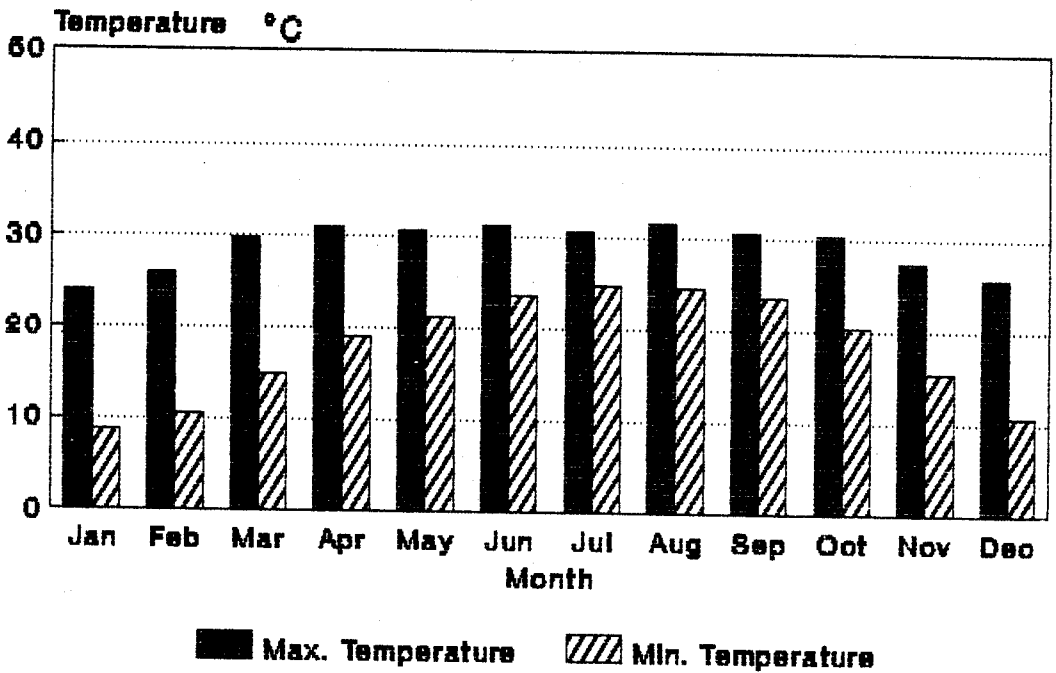


Fig. 1. Climatic data at Mohitnagar (1976-'90): Maximum and minimum temperature

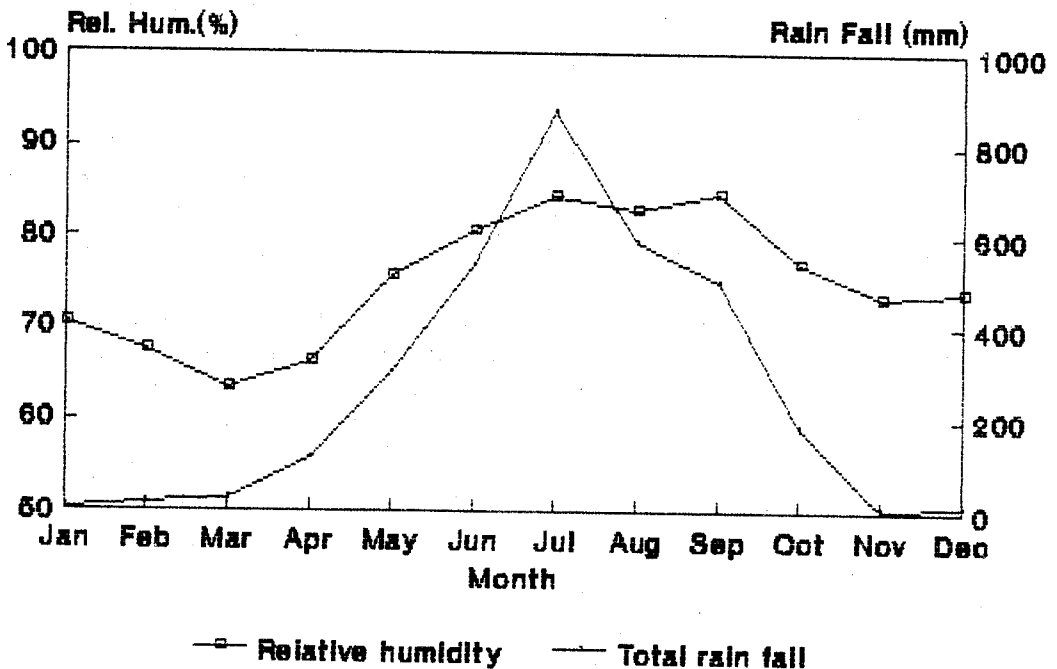


Fig. 2. Climatic data at Mohitnagar (1979-'90): Relative humidity and rainfall

Table II. Correlation coefficients of arecanut yield with weather variables at Mohitnagar.

Variable	Significant correlation coefficient
Previous year (i-1)	
1. RH% of November	-0.82**
2. Minimum Temp. in December	0.62*
3. Max-Min. Temp. in November	-0.61*
4. Max. Temp. in November	-0.67**
Two Years earlier (i-2)	
5. Rainfall in October	0.80**
6. Rainfall in November	0.60*
7. Min.Temp. in December	0.63*
8. Rainfall in December	0.74*
9. Max. Temp. in April	0.65*
10. Min. Temp. in April	0.77**

* Significant at $P=0.05$;

** Significant at $P=0.01$

yield for one year and two years lag period separately. Thus, there were 120 variables (five weather parameters for 24 months) in the study apart from yield. The correlation coefficients obtained were tested for significance at 5 per cent level of probability and significant ones selected for deriving regression equation. Multiple regression equations were fitted to estimate the yield in any year based on the weather variables in the preceding one and two years.

RESULTS AND DISCUSSION

The significant correlation co-efficients between arecanut yield and different weather variables are presented in Table II. There was a positive correlation between yield and maximum temperature ($r = 0.65$) and yield and minimum temperature ($r = 0.77$) of April month two years before. Arecanut ripening starts from middle of April and continues upto first half of July. As the development of arecanut fruit from the floral primordia takes about two years (Murthy

and Bavappa, 1960) a significant correlation with April temperatures two years before, suggests that higher temperatures during April promote the differentiation process of floral primordia. The mean maximum temperature ranged from 24 to 33°C and mean minimum from 15 to 21°C during these years under study.

The next set of variables that have a significant correlation with yield are rainfall for the months of October ($r = 0.80$), November ($r = 0.60$) and December ($r = 0.74$) and minimum temperatures of December ($r = 0.63$) of two years earlier. The rainy season extends between April and September of the year in the region and total rainfall ranges from 2500 to 3000 mm (Fig. 1 and 2). The late rains of October, November and December probably help in mitigating the dry periods during winter months and maintaining a favourable plant water relations to enable the rapid development of floral primordia as this period coincides with the rapid development of inflorescence primordia.

The minimum temperature during December month in the region goes below 15°C reaching as low as 5°C during January (Fig. 1 and 2). The temperature start rising during the month of February. However, present study indicates that only minimum temperature of December is significantly correlated with yield. This suggests that whatever the adverse effect caused by low temperatures to the growing floral primordia is the resultant of the initial low temperatures (i.e., minimum temperatures of December) and subsequent low temperatures do not have much effect.

The maximum temperatures of November ($r = 0.67$) and relative humidity of November ($r = 0.82$) of the previous year had a significant but negative correlation, while minimum temperatures of December month ($r = 0.62$) had

Table III. Regression equations for forecasting arecanut yield at Mohitnagar

Variables	Month	bj	SE(bj)
Previous year (i-1)	Eqn - 1.		
1. Maximum-minimum Temperature	November	-0.92	2.64
2. Relative humidity (PC)	November	-4.68**	1.06
3. Maximum temperature	December	3.16	5.10
4. Minimum Temperature	December	8.82	4.92
Constant		332.1418	
R ²		0.92	
Two years earlier (i-2)	Eqn - 2.		
1. Rainfall	October	0.18	0.14
2. Minimum Temperature	November	5.81	12.19
3. Minimum Temperature	December	3.52	8.41
4. Rainfall	December	0.22	0.43
Constant		-8.03	
R ²		0.736	

* Significant at P = 0.05;

** Significant at P = 0.01

significant positive correlation with arecanut yield. High temperatures (18-30°C) and high relative humidity (61-85%) in November of the previous year might create favourable environment for the development of fungi which may induce tendernut drop in arecanut and result in low yields. Murthy and Pillai (1982) observed fungal as well as insect association with drop of female flowers and tendernuts in arecanut. On the contrary, the high minimum temperatures of December month ($r = 0.62$) of previous year might influence the water relations of the tendernut and reduce the nut splitting and dropping.

It is interesting to compare the findings of the present study with those reported by Vijayakumar *et.al.* (1991). Out of the ten significant correlations obtained in the present study three involved mean minimum temperatures, while Vijayakumar *et.al.* (1991) did not report any correlation with minimum temperature. The positive correlations obtained with winter temperatures in the present study suggests

that in the northern latitudes, the lower temperatures may become a limiting factor in realising the full yield potential of arecanut.

Regression equations were developed to predict the yield using weather variables of the previous year and two years earlier separately. The four significantly correlated variables of the year prior to harvest viz., diurnal variation of temperature in November, November maximum temperature, November relative humidity and minimum temperatures of December month could explain 92 per cent of the variation in yield (Table III). Similarly, the four significant weather variables of two years prior to harvest viz., rainfall during the months of October, November and December and the minimum temperatures during December month, could explain 74 per cent of the variability in the yield.

Stepwise regression analysis was carried out to eliminate 'non-contributing' variables in the first set (Table IV). Relative humidity of

Table IV. Regression equations for forecasting arecanut yield at Mohitnagar

Variables	Month	Equations					
		3		4		5	
		b _j	SE(b _j)	b _j	SE(b _j)	b _j	SE(b _j)
Previous year (i-1)							
1. Relative humidity (PC)	November	4.51**	0.90	-2.60	1.13	-2.73*	0.82
2. Minimum Temp.	December	10.99**	2.56	14.92**	2.72	13.52**	1.87
Two year earlier variables (i-2)							
1. Minimum Temp.	December	—	—	10.37	4.77	—	—
2. Minimum Temp	April	—	—	—	—	10.95*	3.46
Constant		367.08	—	68.38	—	2.30	—
R ²		0.92		0.95		0.97	

* Significant at P = 0.05

** Significant at P = 0.01

November and minimum temperature of December could explain 92 per cent of the yield variation. When the minimum temperature of December of two years earlier was added, the regression equation could explain 95 per cent of the yield variation. When minimum temperature of December of two years earlier was replaced by minimum temperature of April month of two years earlier the equation could explain 97 per cent of the yield variation.

In conclusion, the results of the study suggests that among the different weather parameters studied temperatures play a significant role in determining the arecanut yield in the region. The lower temperatures during winter months could be a limiting factor in realising the yield potential of the crop. This observation may prompt

researchers to look for varieties which can withstand cold temperatures and give high yields. Secondly, the regression equation developed can forecast the arecanut yield by the end of December, i.e., 3-4 months before beginning of the harvesting season.

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