Influence of weather on coconut yield

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ABSTRACT

Studies were conducted on the relationship between four weekly averages of 11 weather variables viz., temperature (maximum and minimum), vapour pressure —VP (forenoon and afternoon), relative humidity—RH (FN and AN), wind velocity, hours of sunshine—HRS, rainfall, evaporation and rainy days and quarterly yield of coconut. The seven lag periods viz., 6-8, 10-12, 17-18, 22-23, 30-31, 35-36 and 44-46 months prior to the harvest of nuts were identified as important. Of these, the last five periods correspond to some of the important developmental phases of the inflorescence like differentiation of ovary and development of stamens, growth of branches of inflorescence and formation of primordia of male flower, process of beginning of the primary bract of the inflorescence, differentiation of the outer or second bract and initiation of primordium of inflorescence.

Introduction

Weather plays an important role in determining the yield of any crop. In a perennial crop like coconut, the influence of weather on the yield is cumulative since every bunch has to go through a long period of 44 months of development from the primordial stage till maturity. The variations in weather parameters during this period thus are bound to affect the yield. Studies conducted so far in this direction by earlier workers like Patel (1938), Balasubramanian (1956), Abeywardena (1968), Prasad Rao (1982), Jacob Mathew *et al.* (1986) and Vijayakumar *et al.* (1986) have established the importance of summer rains. Vijayakumar *et al.* (1986) further listed the important weather variables which had significant correlation with yield of one year ahead, two years ahead and three years ahead of harvest. However, in none of these studies the authors have indicated the critical phases of the development of nuts during which the weather factors play a crucial role. In the present study, an attempt is made to identify the important weather variables during the different critical phases of development of nuts starting from the primordial stage up to harvest of nuts.

Materials and Methods

At CPCRI, Kasaragode coconuts are generally harvested at an interval of about 30 days. Monthly harvest data for a group of 30 palms, growing under rainfed condition in Block RS 29, for the period 1961 to 85 were considered for this

analysis. Since the harvest had been skipped in some of the months, the monthly harvest figures have been grouped on the basis of the following four seasons. viz. June to August (S. W. monsoon), September to November (N. E. monsoon), December to February (Winter) and March to May (Summer). The weekly data on 11 weather variables, Viz. temperature (maximum), vapour pressure—VP (forenoon and afternoon), relative humidity—RH (FN and AN), wind velocity, hours of sunshine—HRS, rainfall, evaporation and rainydays available at CPCRI, Kasaragod were made use of for finding out the influence of weather variables on yield. The data were further grouped into four-week-blocks and in the case of rainfall and rainydays, four week totals and in the case of other vatiables, block averages were considered for analysis. As the coconut primordium is formed about 44 months prior to harvest, for correlation analysis, not only current month's weather, but lag periods up to 208 weeks (4 years or 48 months) were used. Since weather data have been considered in four-week-blocks and yield data on quarterly basis, for working out the lag periods, it was assumed that the weather variables and yield correspond to the middle of each period. Lag periods were first calculated on weekly basis and then converted into months for easier interpretation. Hence the results and discussions are mainly based on monthly lag periods.

Results and Discussion

Table-1 gives an idea about the monthly variation of weather parameters at Kasaragod.

Based on significant correlations obtained and their concentration within a particular period, seven lag periods were identified as important (Table-2). These were 24-36 weeks (6-8 months), 41-52 weeks (10-12 months), 72-80 weeks (17-18 months), 92-100 weeks (22-23 months), 128-137 weeks (30-31 months), 152-160 weeks (35-36 months) and 187-200 weeks (44-46 months). All these lag periods, except the first one, coincide with some of the important developmental phases of inflorescence as described by Patel (1938).

During lag 6-8 months, two of the parameters, namely, temperature-(max.) and hours of sunshine had positive influence on yield whereas RH (AN), wind velocity and rainy days had negative influence. It appears from this that warm and sunny days during this period help retention of tender nuts in the bunch, while more humid days coupled with high wind velocity and rain are not good and may lead to premature nutfall.

During lag 10-12 months, that is during the process of opening of spathe and immediately there after, VP (FN&AN), RH (FN) and rainfall had positive influence on yield, while wind velocity and evaporation had negative influence.

During lag 17-18 months, that is when ovary is first differentiated and when anther lobas and stamens develop, temperature (max.), rainfall, rainy days and evaporation had positive influence, while RH (FN & AN) and wind velocity had negative effect.

Table 1. Monthly weather data at Kasaragod (Mean for the period 1960-81)

Month	Variables										
	Temperature		V P		R H		W V		Total Rainfall	Evapor-ation	Total Rainy-days
	Maximum	Minimum	F N	A N	F N	A N	Km/hr	HRS			
January	31.68	20.11	16.03	17.23	84.50	52.90	2.13	9.31	0.71	4.47	0.05
February	31 88	21.30	18.17	19.05	87.00	56.45	2.36	9.76	0.00	4.85	0.00
March	32.45	23.26	20.48	21.42	87.36	51.09	2.57	9.41	5.57	5.30	0.23
April	33.21	24.97	21.92	22.67	82 35	61.87	2 83	9.14	39.41	5.43	2.55
May	32.42	24.90	22.50	23.30	83.05	68.74	2.75	7.68	225.42	5.50	8.09
June	29.75	23.33	22.21	23.06	91.50	81.98	2.20	3.68	886.51	3.79	23.27
July	28.52	22.96	21.87	22.93	93.90	85.53	2.31	2.58	1105.93	2.62	27.73
August	28.50	22.82	21.77	22.75	94.64	82.84	2.13	3.77	689.50	2.79	23.95
September	29.22	22.76	21.55	22.62	93.82	78.63	1.81	5.97	317.64	3.56	14.77
October	30.60	22.77	21.49	22.56	88.39	72.00	1.71	6.98	175.29	3.66	10 01
November	31.82	22.07	19.08	20.09	88.32	61.09	1.70	7.97	88.50	3.94	5.22
December	32.35	20.81	16.59	17.73	83.36	52.91	1'87	8.46	21.50	4.15	1.22
Mean	31.03	22.67	20.31	21.28	88.19	67.17	2.20	7.06	3555.98*	4.26	117.09*

* Represents total for year

Table 2: Influence of weather variables on yield of nuts—Significant correlations

Lag period Months	weeks	Temperature (Max)	Temperature (Min)	VP (FN)	VP (AN)	RH (FN)	RH (AN)	Wind velocity	HRS	Total rainfall	Evapo-ration	Rainy days
		1	2	3	4	5	6	7	8	9	10	11
6-8	22							—0.429				
	23	0.441	0.481	0.434								
	24							0.443				
	25								0.454			—0.451
	26								—0.477			
	27											
	28											
	29		—0.437	—0.507								
	30	0.705		—0.520		—0.621	0.529	—0.535	0.466	—0.442		—0.482
	31		0.417									
	32											
	33						—0.483		0.465			
	34							—0.496		0.448		
10-12	39		0.497	0.426	0.536							
	40											
	41											
	42		—0.482			0.449		—0.506			—0.628	
	43		0.447									
	44			0.449	0.458							
	45					0.440						
	46		—0.456					—0.561				
	47	0.535										
	48											
	49					0.461				0.442	—0.521	
	50							—0.500			—0.433	

		1	2	3	4	5	6	7	8	9	10	11
17–18	70							—0.426				
	71								0.455			
	72											
	73											
	74	0.497				—0.513		—0.479	—0.513			
	75									0.505		0.459
	76											
	77					—0.527					0.429	
	78						—0.424					
22–23	90								0.440	0.465	—0.462	0.486
	91											
	92											—0.429
	93					—0.427						
	94											
	95											
	96											
	97					—0.580						
	98						0.526			0.531		
30–31	126									0.522		0.522
	127						—0.479					—0.524
	128						0.534			0.515		0.782
	129			—0.480								
	130								—0.467			
	131											
	132										0.502	—0.423
	133											
	134	0.448										
	135									0.458		0.458

		1	2	3	4	5	6	7	8	9	10	11
35-36	150											
	151					0.437				0.453		
	152	−0.493	−0.470				0.421					
	153					0.449						
	154				0.485							
	155		−0.431			0.469						
	156											
	157											
	158			0.469								
44-46	185								0.438	−0.534		−0.510
	186											
	187											
	188	−0.455	−0.562			0.579						
	189											
	190					−0.452						
	191					0.536						
	192											
	193											
	194										−0.452	
	195											
	196											
	197											
	198	0.602					−2.439			−0.581		−0.622

Note: All the coefficients listed above are significant at 1% or level of significance.

Lag 22-23 months brought out the importance of HRS, rainfall and RH(AN) which had positive correlation with yield and evaporation which had negative correlation. During this period, growth of rachille or branches of the inflorescence takes place and primordium of male flowers are formed.

During lag 30–31 months, that is during the process of beginning of fourth bract or the primary bract of the inflorescence temperature (max.), rainfall, evaporation and rainy days had positive influence while VP (FN) and HRS had negative influence.

During lag 35–36 months, VP (FN&AN), RH(FN&AN) and rainfall had a positive influence and temperature (max. and min.) had a negative influence. During this period differentiation of the outer or second bract takes place.

During lag 44–46 months, that is during initiation of primordium and before RH (FN) and HRS had positive influence while temperature (min.), RH(AN) evaporation and rainy days had negative influence.

The results thus show (Table 3) that temperature (max) had a positive influence towards the later part of development (lag 6-8, lag 10–12 and lag 17-18 months) of the inflorescence. Towards the early part (lag 35-36 months) it had a negative influence. Temperature (min) showed its influence which is negative, towards early part of development of the inflorescence. These suggest that towards initiation of primordium and early part of development of the inflorescence, cooler days and nights are preferable. VP (FN&AN) exhibited it's influence which is positive, towards the early period (lag 35-36 months) and the last period (lag 10–12 months). During the middle period its effect was not observed.

Table 3: Influence of weather at the difference stages of the development of nuts—Summary of results

Variables	Lag period in months						
	6-8	10–12	17–18	22-23	30–31	35-36	44–46
Temp (Max)	+	+	+		+	—	
Temp (Min)						—	—
VP (FN)		+			—	+	
VP (AN)		+				+	
RH (FN)	—	+	—	—		+	+
RH (AN)	—		—	+		+	—
WV	—	—	—				
HRS	+			+	—		+
Rainfall		+	+	+	+	+	—
Evaporation		—	+	—	+		—
Rainydays	—		+				—

\+ Indicates significant positive correlation at 1% or 5% level
— indicates significant negative correlation —do—

RH (FN) exhibited a positive influence during the early period of develoment (lag 44–46 and lag 35-36 months), while it had a negative influence during middle period. RH (FN) showed a negative influence during the formation of primordium (lag 44-46 months), thereafter its influence was positive till lag 22-23 months and then again negative towards the later periods. Wind velocity had only a negative influence that too towards the later periods of development (from lag 17–18 months). HRS generally had a positive influence except during lag 30-31 months when it had negative influence. Rainfall had positive influence throughout except during the initiation of primordium (lag 44-46 months) when it was negative. Rainy days however did not show the same trend. But, like rainfall, it had a negative influence at the time of initiation of primordium. The trend of evaporation was alternatively negative and positive during the development of inflorescence and at the time of the primordium initiation it's effect was negative.

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Discussion

N. Mohankumaran (KAU, Vellayani): Weather data and correlation 46 to 48 months prior to harvest may also be examined (since according to Patel, the flower bud initiation in coconut take place about 44 months prior to harvest of a particular bunch). Detailed studies will have to be conducted on the influence of the weather parameters (i) during the pre-initiation period (ii) during the period between initation and spathe opening and (iii) during post-spathe opening period.

K. Vijayakumar: The suggestions will be taken care of in our future studies.

O. P. Bishnoi (HAU, Hisar): Use of weather variables during different phenonphases may be better correlated and utilised to improve yield prediction regression rather than using calender month meteorological data.

K. Vijayakumar: Agreed. The same will be attempted in future studies.