Journal of Spices and Aromatic Crops 9 (2) : 157-160 (2000)

Changes in climatic elements and their impact on production of cardamom (*Elettaria cardamomum* Maton) in the Cardamom Hills of Kerala, India

M Murugan, N Mini Raj[1] & Carmel Rani Joseph

Cardamom Research Station
Pampadumpara - 685 556, Kerala, India.

Received 23 November 1999; Revised 10 April 2000; Accepted 22 April 2000.

Abstract

The change in climatic elements namely, temperature and precipitation in Cardamom Hills (Kerala, India) was studied by analysing the weather data for 20 (temperature) and 40 years (precipitation). Minimum temperature exhibited drastic variation over the years. The difference between the warmest and coolest month had narrowed considerably and the days have become warmer markedly. Except during 1967–76 (Decade-II) the total annual average precipitation received was more or less equal. Even though the total number of rainy days has increased, the distribution pattern was erratic during the last decade. The rainfall parameters had positive correlation with production of cardamom (*Elettaria cardamomum*) with significant relationship for number of rainy days.

Key words : cardamom, climate, *Elettaria cardamomum*, production.

Weather and agriculture are mutually dependent. The weather prevailing in an area affects crop production, at the same time agricultural manipulations influence the weather also (Anon 1941). The climate of the high ranges of Kerala, India, is classified as monsoon rain forest climate (Am) which comes under the group of tropical rainy climate. Am climate is found along tropical coasts backed by highlands with strong onshore movement of maritime air during summer. These seasonal winds are not always of monsoon origin and are the cause of strong seasonal precipitation (Ramanathan & Ramakrishnan 1933). The well developed monsoon systems approximately last for 6 months. High ranges form the roof of Central Travancore and from here many small and large rivers originate. The natural vegetation is tropical evergreen forest. About 870 sq km of reserve forest in the Udumbanchola, Devikulam and Peerumedu taluks of high ranges in Idukki district are declared as Cardamom Hills. Cardamom (*Elettaria cardamomum* Maton), black pepper (*Piper nigrum* L.) and coffee (*Coffea arabica* L.) are major crops grown in these hills. An analysis of data on temperature and precipitation recorded in this region and their impact on production of cardamom is discussed.

Precipitation data recorded from 1957 onwards and temperature data recorded from 1978 onwards at Cardamom Research Station, Pampadumpara (1100 m above MSL), were taken for the analysis. The monthly and annual means of both maximum and minimum temperatures as well as precipitation for the 10 year period were worked out by simple arithmetic mean. The temperature range was calculated by taking the difference between the mean values of the warmest and coolest month (Trewartha 1954). Temperature data was expressed as the average of Decade-I (1978–1987) and Decade-II (1988–1997) and precipitation data expressed as the average of Decade-I (1957–1966), Decade-II (1967–1976), Decade-III (1977–1986) and Decade-IV (1987–1996). Weather data of each day, month and year was studied for comparison and discussion.

[1]Department of Plantation Crops, College of Horticulture, Kerala Agricultural University, Thrissur - 680 656, India.

Temperature

The monthly and annual averages of maximum and minimum temperatures for two decades is presented in Table 1. Generally the arithmetic mean of temperature is taken to represent temperature conditions. However, frequency of occurrence of elevated temperature and the range of variation would also be useful for comparisons. The annual average of maximum temperature for the period 1978-87 (D-I) was 27.9°C while it was 27.1°C for the period 1988–1997 (D-II). There was a decrease of 0.8°C between the decades. The reverse was the trend in average annual minimum temperature. It increased by 0.6°C as the decade passed. The difference between the warmest and coolest month for D-I was 7°C whereas it was 6.1°C for the next decade. This indicated that the range in temperature had become less and the high temperature remained throughout the year irrespective of colder or warmer months. The frequency of occurrence of elevated maximum temperature (>30°C) was high in the summer months of D-I whereas the minimum temperature values were high during the summer months of D-II.

Table 1. Average monthly and annual maximum and minimum temperature recorded at Cardamom Research Station, Pampadumpara

Month	Period			
	1978–1987 (D–I)		1988–1997 (D–II)	
	Max°C	Min°C	Max°C	Min°C
January	24.6	13.0	25.8	13.0
February	29.2	14.0	28.3	14.1
March	30.8	15.4	30.5	15.9
April	31.8	15.7	30.9	17.1
May	31.2	17.2	29.3	17.8
June	26.3	15.2	26.8	17.2
July	25.9	16.0	24.3	16.2
August	26.1	16.1	24.9	16.6
September	27.3	16.3	26.3	16.8
October	27.5	15.6	27.0	16.5
November	28.6	14.6	26.0	15.3
December	25.6	14.1	25.7	13.5
Yearly average	27.9	15.2	27.1	15.8

Cardamom is very sensitive to temperature fluctuations (Jacob *et al.* 1995). There has been a drastic reduction in tree cover due to deforestation, felling and excessive opening of canopy during the last decade and this could be the reason for the increase in minimum temperature (Korikanthimath *et al.* 1988). Land use pattern of the hills has also changed to a great extent. More light demanding crops like coffee, black pepper, arecanut, etc. were being cultivated in place of cardamom, which further reduced the canopy cover.

Another factor affected by atmospheric temperature was soil temperature. In hills especially, removal of canopy cover may have an adverse effect on soil temperature since the high altitude sunlight has high energy light particles which can increase the soil temperature quickly than in the plains (Garbell 1947). Under shadeless conditions, elevated soil temperature (36°C) and the strong wind movement increases evapo-transpiration and the soil dries up quickly. All these inter related changes in microclimate would affect the growth and the development of cardamom.

Precipitation

Highlands control non zonal rainfall distribution over the earth. Along the windward sides of high-

Table 2. Average monthly and annual precipitation (mm) recorded at Cardamom Research Station, Pampadumpara

Month	Period			
	1957–1966 (D-I)	1967–1976 (D-II)	1977–1986 (D-III)	1987–1996 (D-IV)
January	014.3	006.4	019.0	031.0
February	012.5	005.8	012.3	017.5
March	043.5	025.0	035.0	035.6
April	082.1	073.5	067.7	121.0
May	158.0	059.5	094.6	100.4
June	262.7	241.4	398.7	308.8
July	408.8	404.8	331.4	368.7
August	270.2	280.9	229.5	273.0
September	163.6	151.0	225.8	164.5
October	291.9	207.6	253.3	268.9
November	171.7	150.0	189.0	185.5
December	047.6	060.2	060.3	052.8
Total	1926.9	1666.0	1916.6	0927.7

lands, excessive and thick air masses ascend resulting in greatly increased preiptitation. The rainfall data for the last 40 years was divided into four decades for comparison and are presented in Tables 2 and 3. Except during 1967–1976 (D-II), the average annual total rainfall was more or less similar (1916.6–1927.7 mm). However, during D-II, it was only 1666.1 mm. In case of distribution of rainfall (Table 3), as the decade passed, the number of rainy days increased from 120.8 days during D-I to 152.8 days during D-IV. But this increase often did not indicate a well distributed rainfall pattern. A perusal of the yearly data revealed that summer months received only scanty showers during the last decade. From D-I to D-IV there was an increase in total number of rainy days.

D-II recorded the lowest production of cardamom while total rainfall and percentage of summer rainfall as well as percentage of summer rainy days were minimum. D-I recorded the highest number of summer rainy days which might have contributed to higher total rainy days and rainfall to produce higher yields of cardamom than D-II (Table 4). Even though all the characters of rainfall

Table 3. Average monthly and annual rainy days recorded at Cardamom Research Station, Pampadumapra

Month	Period			
	1957–1966	1967–1976	1977–1986	1987–1996
	(D-I)	(D-II)	(D-III)	(D-IV)
January	01.4	00.5	02.0	02.2
February	01.1	00.7	02.4	01.9
March	02.7	02.3	02.6	03.1
April	06.0	05.6	07.0	06.9
May	08.7	05.6	09.0	09.2
June	15.9	19.6	24.8	23.6
July	22.1	25.4	25.3	25.9
August	19.1	20.3	23.3	24.7
September	13.8	14.2	18.2	16.3
October	15.8	16.0	16.1	18.5
November	09.5	10.4	13.8	15.0
December	03.8	05.5	06.5	05.0
Total	120.8	126.1	151.2	152.8

Table 4. Rainfall pattern and production of cardamom in Cardamom Hills

Decade	Total rainfall (mm)	Total rainy days	% of summer rainy days	% of summer rainfall	Average production (MT)
D-I (1957–1966)	1926.6	120.8	16.1	16.4	2905
D-II (1967–1976)	1666.1	126.1	10.2	11.6	2603
D-III (1977–1986)	1916.6	151.2	11.9	15.2	3042
D-IV (1987–1996)	1927.7	152.8	15.8	15.2	3319

Table 5. Association of rainfall pattern with cardamom production in Cardamom Hills

Character	Total rainfall	Total rainy days	% of summer rainy days	% of summer rainfall	Average production
Total rainfall	1.000	0.4525	0.9660**	0.7792	0.3391
Total rainy days		1.000	0.8788**	0.2076	0.8788**
% of summer rainfall			1.000	0.8251	0.1054
% of summer rainy days				1.000	0.2391
Average production					1.000

* Significant at 5% level; ** Significant at 1% level

were positively correlated with the production of cardamom, a significant correlation was observed only between total number of rainy days and yield (Table 5). During 1998–99, there was no rain continuously for 93 days in summer. Hence the production was only 20% of the average production. An annual rainfall of 2000 mm with uniform distribution was hence considered ideal for cardamom.

References

Anonymous 1941 Yearbook Agriculture. U S Department of Agriculture, Washington D C.

Garbell M A 1947 Tropical and Equatorial Meterology. Pitman Publishing Corp., New York.

Jacob J A, Ancy Joseph & Murugan M 1995 Cardamom and climate. Spice India 8 (6) : 12-14.

Korikanthimath V S, Ankegowda S J, Yadukumar, N Rajendra Hedge & Hosmani M M 1998 Mixed cropping of arabica coffee and cardamom : Influence on microclimatic and physiological characteristics. J. Med. Aromatic Plant Sci. 20 : 394-396.

Ramanathan K R & Ramakrishnan K P 1933 The Indian South West monsoon and the structure of depressions associated with it. Mem. Indian Met. Dept. Vol. 26 Part I.

Trewartha T G 1954 An Introduction to Climate. Mc Graw-Hill Book Company Inc., London.