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Analysis of rainfall of the high rainfall tract of northern agro-climatic zone of Kerala

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Abstract

Analysis of rainfall of the high rainfall tract of northern agroclimatic zone of Kerala was carried out for 26 years (1980–2005) to schedule spice crop management practices precisely. The analysis indicated that the tract received 4461 mm of annual rainfall in 145 rainy days. South west monsoon (June to September) alone contributed 75% of annual rainfall and July was the rainiest month (1117 mm) with 27 rainy days. The length of growing period was identified between 18th standard week to 47th standard week (from 30th April to 25th November) with a mean rainfall of 4284.1 mm. The pre-monsoon period from 2nd April to 6th May (between 14th week to 18th week) with a mean rainfall of 180.6 mm was the right time for land preparation for annual crops like ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) and the period between 30th April to 27th May (18th week to 21st week) with a mean rainfall of 244.4 mm was ideal for planting including first mulching and first schedule of fertilizer application for these crops. The probability of getting 50 mm rainfall per week was more than 60% during the 19th week (7th to 13th May). This is the time for prophylactic plant protection, application of first schedule of fertilizer application and shade regulation for black pepper (*Piper nigrum*) and tree spices. The second schedule of these operations has to be done during the 36th to 39th week (3rd to 30th September) as this period is relatively rainless (September rainfall was 349.6 mm). Though the tract receives high rainfall, there is moisture stress between December and March and adequate moisture conservation (or irrigation wherever possible) is essential particularly for perennial crops in juvenile stage.

Keywords: agro-climatic zone, Kerala, rainfall analysis, spice crop management.

Introduction

Kerala is an elongated coastal state situated at the south-west tip of peninsular India between 8°15′N and 12°50′N latitudes and 74°50′E and 77°30′E longitudes and divided into five agro-climatic zones based on physiography, climate, soil characteristics, sea water intrusion, irrigation facilities and land use pattern (KSLUP 1997). The south-west monsoon current, which brings in most of the annual rainfall, gets a forced ascent at the western ghats and the windward slopes experience very heavy rainfall, which is not uniformly distributed. These western windward slopes form the watershed for a large number of rivers (Simon &

Mohankumar 2004). The northern agro-climatic zone consistsing of Kasaragod, Kannur, Kozhikode and Malappuram districts covering 28.2% of the area of the state, receives rainfall during both south-west and north-east monsoons with an annual average rainfall of 3379 mm. However, there is a tract that is located within this zone in the western side of western ghats in Kozhikode and Kannur districts that receives very high rainfall (NARP 1989). Spice crops like black pepper (*Piper nigrum* L.), ginger (*Zingiber officinale* Rosc.), turmeric (*Curcuma longa* L.), nutmeg (*Myristica fragrans* Houtt.), clove (*Syzygium aromaticum* (L.) Merr. et Perry), garcinia (*Garcinia* spp.) and vanilla (*Vanilla planifolia* Andr.) are grown in this tract. The quantum and distribution of rainfall are important determinants of crop productivity. Joseph *et al*. (2001) and Rao & Krishnakumar (2005) reported that there was a decline in quantum and distribution of rainfall in Kerala over the years. Our objective was to analyse the rainfall pattern for scheduling crop management practices of spice crops based on rainfall distribution and to find deviations, if any, in this high rainfall tract.

Materials and methods

The monthly rainfall data of 26 years (1980 to 2005) and daily rainfall data for 15 years (1991 to 2005) available at Indian Institute of Spices Research, Experimental Farm, Peruvannamuzhi, Kozhikode District (Kerala) (11°.34′N, 75°.48′E and 60 m MSL) were used in this study. The variability of rainfall on daily, weekly, monthly, seasonal and annual basis was studied by using standard statistical methods (Panse & Sukhatme 1985). The Conditional Probability (CP) (%) was calculated for weekly rainfall as follows:

a) Calculation of normal=$(\mu\text{-}x)/\sigma$, where, μ=mean of n observations, x=condition adopted i.e. rainfall expected to receive during particular week, and σ=standard deviation

b) Table value from standard normal distribution table corresponding to the value of normal deviate was computed

c) CP (%)=table value * 100

The percentage contribution of rainfall during different seasons and months were worked out. The normal range of annual and seasonal rainfall was also computed by keeping -19% deviation from mean as lower limit and +19% deviation from mean as upper limit. Daily rainfall was divided into different intensity groups namely, very light (< 3 mm), light (3–7 mm), moderate (7–35 mm), rather heavy (35–65 mm), heavy (65–125 mm) and very heavy (>125 mm) and their distribution was studied. Length of growing period was calculated as suggested by Higgins & Kassam (1981). Based on rainfall analysis, timing of field operations for spice crops were suggested.

Results and discussion

Annual rainfall

The mean annual rainfall of this tract was 4461 mm spread over 145 days with coefficient of variation of 14.9%. Maximum rainfall (5908 mm) was received during 1980 that was 32.4% higher than the mean and occurred in 158 days. Minimum rainfall of 3355 mm was recorded during 2003 in 137 days and it was 24.8% lower than the mean. The normal range of annual rainfall was 3614 mm to 5309 mm. Out of 26 years, only one year (2003) recorded below (3355 mm) this range, while during 1980 (5908 mm), 1981 (5321 mm), 1994 (5370 mm) and 1997 (5798 mm), recorded above the normal range indicating that rainfall was more stable over the years. The number of rainy days per year ranged from 112 to 165 days with a CV of 10.6% (Table 1).

Seasonal rainfall

The highest rainfall occurred during south-west monsoon (SWM) (June to September) (3351.4 mm) followed by north-east monsoon (NEM) (October to November) (623.7 mm), dry hot summer (DHS) (March to May) (409.3 mm) and dry cool winter (DCW) (December to February) (77.3 mm). The percentage of contribution was high with SWM (75%) and remaining 25% contributed by other seasons (Table 2). For SWM, the

Table 1. Characteristics of monthly rainfall and number of rainy days at Peruvannamuzhi, Kozhikode District, during 1980 to 2005

Month	Rainfall (mm)							Rainy days					
	Max.	Min.	SD	CV (%)	Mean	SEm±	% of annual	Max.	Min.	SD	CV (%)	Mean	SEm±
January	201.2	0.0	42.7	251.5	17.0	8.4	0.38	8	0	1.9	188	1.0	0.37
February	90.0	0.0	21.8	176.0	12.4	4.3	0.28	6	0	1.6	165	1.0	0.31
March	80.0	0.0	23.0	133.7	17.2	4.5	0.39	5	0	1.5	91.1	1.6	0.29
April	368.0	0.0	109.2	87.2	125.2	21.4	2.81	15	0	4.5	58.9	7.6	0.88
May	635.3	49.5	185.1	69.3	267.0	36.3	5.98	24	5	4.8	41.1	11.6	0.94
June	1567.0	719.0	263.7	24.4	1080.0	51.7	24.22	30	16	3.7	15	24.7	0.73
July	1991.0	580.0	395.0	35.4	1117.0	77.5	25.03	31	20	3.2	11.7	27.2	0.63
August	1288.0	561.0	201.1	25.0	804.6	39.4	18.03	31	16	3.2	12.5	26.1	0.63
September	910.0	57.0	213.4	61.0	349.6	41.9	7.84	27	5	5.9	39.6	15.0	1.16
October	792.7	194.0	150.8	35.8	420.8	29.6	9.43	27	10	4.2	24.3	17.3	0.82
November	419.0	40.0	117.7	58.0	202.9	23.1	4.55	17	4	3.4	35.8	9.6	0.67
December	263.0	0.0	70.8	148.7	47.6	13.9	1.07	11	0	2.9	114	2.5	0.57
Annual rainfall	5908.0	3355	663.2	14.9	4461.0	130.1	-	165	112	15.4	10.6	145	3.02

normal rainfall range was 2714.7 mm to 3988.2 mm. The rainfall received during four years was above and three years below this range. During NEM, the normal range of rainfall was 505.2 mm to 742.2 mm and during five years the rainfall received was above and seven years below this range. During DHS, the normal rainfall range was 331.6 mm to 487.1 mm and 9 years received above and 11 years received below the normal range of rainfall. Pre-monsoon months (March to May) account for the major thunderstorm activity and the winter season is characterized by minimum clouding and rainfall (Ananthakrishnan *et al*. 1979).

Monthly rainfall

The monthly rainfall during January to March was less than 30 mm with high CV (Table 1). Rainfall increased gradually during April and May and CV for monthly rainfall decreased proportionately. At the onset of SWM during June, there was a sudden increase in rainfall and this high rainfall continued up to August and at the end of the SWM season in September, the rainfall was less. At the onset of NEM, the rainfall again increased in October and decreased in November and subsequently the rainfall decreased to less than 50 mm in December with high CV. The mean monthly rainfall was the highest in July. However, the CV was slightly higher in July than June and August. July alone contributed 25.0% of annual rainfall followed by June (24.2%) and August (18.0%). The CV for monthly rainfall during April–November was less than 100% and rainfall was more dependable. A similar trend was also observed in number of rainy days (Table 1). The rainy days for four months (December–March) were less than three with high CV. During this period, crops may suffer for want of moisture and adequate conservation measures are required.

Weekly rainfall

The mean weekly rainfall received during the first 13 weeks was low (10 mm week^{-1}) with high CV (>200%). The weekly rainfall between 14th to 21st week ranged between 29.3

Table 2. Seasonal rainfall characteristics at Peruvannamuzhi, Kozhikode District, during 1980 to 2005

Season (Months)	Rainfall (mm)			SD	CV (%)	% contri- bution
	Max.	Min.	Mean			
Dry, hot summer (March–May)	824.0	103.0	409.4	206.3	50.4	9.0
South west monsoon (June–September)	4770.0	2235.8	3351.4	667.9	19.9	75.0
North east monsoon (October–November)	1017.3	300.4	623.7	187.4	30.0	14.0
Dry cool winter (December–February)	263.0	0.0	77.3	80.1	103.7	2.0

mm to 78.3 mm and CV was less than 150%. The rainfall from 22nd week (28 May to 3 June) onwards gradually increased and correspondingly CV was reduced. A maximum mean weekly rainfall of 291.9 mm was recorded during the 30th week (23–29 July). However, the highest weekly rainfall of 778.0 mm was received during the 26th week (18–24 June) during 1992. The CV was less than 100% during 22nd (28 May to 3 June) to 45th week (5–11 November).

Weekly rainfall probabilities

The probability of getting 50 mm rainfall per week was more than 60% during 19th week (7–13 May) and continued up to 44th week with a slight dip in 21st week (21–27 May, a period prior to onset of SWM) and another deep dip in 38th week (17–23 September, a period prior to onset of NEM). An amount of 50 mm rainfall per week can be taken as the minimum requirement for planting of rhizomatous crops like ginger and turmeric. The probability of 100 mm per week exceeds 60% limit from 23rd week (4 –10 June, just after onset of SWM) to 35th week (27 August to 2 September). Again it occurs in two weeks ie, 40th (1–7 October) and 41st (8–14 October)week. For the probability of 150 mm, it exceeds 60% probability between 23rd and 32nd week (4 June to 12 August) and for 200 mm, 60% probability occurs between 24th and 31st week (11 June to 5 August). The period between 24th and 34th week (11 June to 26 August) which is a high rainfall period, adequate drainage is necessary and protection of top soil with organic mulch or cover crops is essential to prevent soil loss due to erosion particularly in undulating land.

Crop management planning

Length of growing period was identified when weekly rainfall exceeded potential evapo-transpiration of that week (Fig 1). In this tract it occurred from 18th standard meteorological week (30 April to 6 May) and continued up to 47th week (19–25 November) and rainfall during this period was stable with less CV. Out of 145 rainy days in a year, 22% of rainfall was of light and very light intensity; 46% of rainfall occurred in moderate intensity and 32% of rainfall was of rather heavy, heavy and very heavy intensity.

Soil erosion and runoff is common during these heavy rainfall periods and mostly happens during SWM period (June–September). Appropriate conservation measures like bunds, trenches and mulch

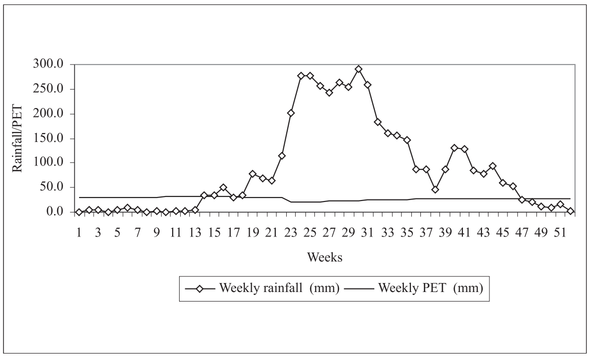

Fig. 1. Length of growing period at Peruvannamuzhi, Kozhikode District

application is needed. Land preparation for planting ginger and turmeric has to be taken up during 14^{th} week (2–8 April) to 18^{th} week (30 April to 6 May). The mostly sloppy nature of land permits manual way of preparation by using spade or crowbar, and planting has to be completed during 18^{th}–21^{st} week (30 April to 27 May). As soil depth is shallow in many places, raised bed planting has to be resorted to. Mulching has to be done after planting that prevents soil splashing and exposure of seed rhizome to scorching sun and also regulates the soil temperature. Application of mulch at 5–10 t ha^{-1} (mostly mixed green leaves available in this tract) would add lot of organic matter and enrich the soil and encourages native microorganisms in the ecosystem. Mulching should be done two or three times depending upon decomposition and until SWM completes at the end of September. Mulching has to be accompanied by earthing up operation and is essential for proper rhizome formation of rhizomatous crops.

First dose of fertilizer application, prophylactic plant protection and shade regulation has to be completed during 18^{th} and 21^{st} week (30 April to 27 May) and second schedule has to be practiced during 36^{th} week (3–9 September) to 39^{th} week (24–30 September). Beyond November, rainfall is less or nil and harvesting has to be scheduled depending upon the maturity of crop / variety. Though the tract receives high rainfall, moisture stress occurs during December–March due to high temperature (33°C–37°C), bright sunshine (6–10 h day^{-1}) and evaporation (3–5 mm day^{-1}); hence adequate moisture conservation measures or irrigation wherever possible is essential.

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References

Ananthakrishnan R, Parthasarathy B & Pathan J M 1979 Meteorology of Kerala. Contribution to Marine Sciences, University of Cochin, Cochin.

Higgins G M & Kassam A H 1981 Regional assessments of land potential: A follow-up to the FAO/UNESCO Soil Map of the World. Nature and Resources 17 (4): 11–23.

Joseph P V, Anu Simon & Venu G Nair 2001 Monsoon and its variability. In: Workshop on Monsoon Rainfall Potential and its Judicious Utilization, 16–17 January 2001, Cochin University of Science and Technology, Cochin.

Kerala State Land Use Board (KSLUP) 1997 Kerala State Resource Based Perspective Plan 2020 AD. Kerala State Land Use Board, Thirvannanthpuram.

National Agricultural Research Project (NARP) 1989 National Agricultural Research Project-Status Report-Northern Zone, Kerala Agricultural University, Thrissur.

Panse V G & Sukhatme P V 1985 Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi.

Rao G S L H V P & Krishnakumar K N 2005 Monsson onset over Kerala (India): 1870–2004. J. Agrometeorol. **7**: 161–167.

Simon A & Mohankumar K 2004 Spatial variability and rainfall characteristics of Kerala. Proc. Indian Acad. Sci. (Earth Planetary Sci.). 113: 211–221.