GAU Res. J. 1996. 22 (1) : 72-79

An Appraisal of Monsoon Rainfall at Anand, Gujarat

H. Venkatesh, H. R. Patel, A. M. Shekh and R. S. Parmar

Department of Agricultural Meteorology, Gujarat Agricultural University, Anand-388 110

ABSTRACT

Seasonal rainfall of Anand for 38 years (1957-94) has been studied for prognosis of monsoon rainfall during 1995. Use of statistical procedures like two way analysis of variance, Cramer's inequality and autocorrelation respectively indicated that (i) the time of withdrawal is not related to the time of onset (ii) 1974-79 received significantly high rainfall and (iii) significant relationship exists in the series at six and ten years lag. The study further indicated that random fluctuations prevailed in the length of growing season after the year 1980.

(Received on 24th July, 1995)

INTRODUCTION

The Indian people are optimistic every summer that the ensuing monsoon would bring respite to his annual miseries. As such, the delay in the monsoon of 1995 has created aspersions in both the common man as well as the Government of the possible difficulties in the ensuing months, particularly towards drinking water scarcity and increase in prices of essential commodities. In such contingencies as this, it is useful to anticipate the possible behaviour of the monsoon, particularly the rainfall and the withdrawal of monsoon. With this background, an attempt has been made here to analyse the behaviour of the south-west monsoon during the past 38 years for which rainfall records are available for Anand (Lat. 22° 35'N, Long 72° 55'E) to guesstimate the monsoon of 1995.

MATERIALS AND METHODS

The daily rainfall data of the 38 years' record (1957-94) available since the inception of the agrometeorological observatory at the Gujarat Agricultural University, Anand Campus have been considered for analysis in the study. The criteria for the onset and the withdrawal of the southwest monsoon have been adopted from Anonymous (1988). Acoording to anonymous (1988), June 15 is the normal date of onset at Anand. The onset being a dynamic and random phenomenon, it would be appropriate to assign onset 'period' rather than 'date'. Further, frequency analysis of the data of Anand showed that the 2nd and 3rd weeks of June experienced highest frequency of onset of the southwest monsoon. Also, Rao (1976) has indicated that Sept., 23rd is the normal date of withdrawal of the

southwest monsoon for the region. Keeping the rainfall distribution characteristics and considering one week as the cut-off limit between early, normal and late categories, the following categorization logically emanates.

Category of period	*Onset*	*Withdrawal*
Very early (VE)	—	Before Sept.. 1st
Early (E)	1st week of June	1st and 2nd week of Sept.
Normal (N)	2nd and 3rd weeks of June	3rd and 4th week of Sept.
Late (L)	4th week of June	After Sept.. 30th
Very late (VL)	After June 30th	—

The data of seasonal rainfall amount and the periods of onset and withdrawal of monsoon have been subjected to appropriate statistical tests. Cramers's test (WMO, 1971) has been employed for evaluating the significance of rainfall in successive five-year periods during the last 35 years (1960-1994). Two-way analysis of variance (Korin, 1977) has been performed for evaluating the significant occurrences between different periods of onset and withdrawal of the monsoon. The auto correlation technique has been utilized to know whether any significant relationship existed within the historical rainfall series of Anand.

RESULTS AND DISCUSSION

Seasonal rainfall characteristics at Anand

Rainfed agriculture demands good seasonal rainfall for sustained productivity. Anand receives a mean monsoon seasonal rainfall of 836.7 mm with a coefficient of variation of 38%. The highest rainfall occurred in the year 1976 (1712 mm), while the lowest occurred in the year 1986 (286 mm). Analysis of Cramers's test statistic, t_k, (WMO, 1971) presented in Table 1 suggests that the three periods covering the years 1970 to 1984 along with the last period (1990-94) experienced higher rainfall than the long term mean, while the remaining three periods received lower rainfall than the long term mean. However, in the period 1975-79 alone Anand received significantly higher seasonal rainfall while the rainfall in the period 1985-89 was very low and close to statistical significance at 5% level.

Onset of monsoon

Besides the amount of rainfall, the onset of monsoon determines crop production capability of the region. Seasonal rainfall occurrence in yeras of different periods of onset is portrayed in Fig. 1. It is seen that the monsoon onset was normal in 52.6% of years, while it was 15.8% in the remaining three categories. It is noticed that high and low rainfall occurrences alternated during the years of very late onset of monsoon. However, the variations in magnitude did not have any set pattern. The observations suggested that the rainfall during 1995 could exceed the rainfall of 1991, which was 643 mm, but post-facto, it is noticed that the seasonal rainfall for 1995 was 545.1 mm.

TABLE 1

Interperiodic variability of rainfall at Anand.

Periods	*Mean*	r_k	t_k	*Significance*
1960-64	715.60	-0.35	-0.82	NS
1965-69	699.20	-0.40	-0.94	NS
1970-74	841.80	0.05	0.11	NS
1975-79	1119.60	0.93	2.34	
1980-84	891.00	0.21	-1.73	NS
1985-89	600.80	-0.71	-1.73	NS
1990-94	911.60	0.27	0.63	NS
Overall mean :	825.66	SD : 317.70	CV = 38.5%	

*Significant at 0.05 level.

Withdrawal of monsoon

In unison with the onset, the time of withdrawal of monsoon determines the length of the growing season with respect to moisture availability and, therefore, plays a vital role in determining crop productivity. Fig. 2 represents the interannual variations of rainfall at Anand during different periods of withdrawal of the monsoon. Anand experienced normal withdrawal in 42.1% of the years under study. While early and late withdrawal was noticed in 23.7% of years each, very early withdrawal was noticed in 10.5% of years. It is further noticed that the monsoon and its intensity have shown increasing trend during years of very early withdrawal of monsoon. In the other categories, no specific trend was observed and the data length is not sufficient for statistical analysis.

Length of growing season

An attempt has been made to combine the occurrences of different periods of withdrawal with onset of the southwest monsoon in order to analyse the length of growing season in individual years. Fig. 3 clearly indicates that the length of the growing season fluctuated erratically after 1980. Further, it is important to note that all the four years of very early withdrawal occurred during this period. The two way analysis of variance (Korin, 1977) as shown in Table 1 indicated that the withdrawal of monsoon varied non-significantly with the onset monsoon at Anand, implying that the length of growing season does not have any significant relation with the onset.

Fig. 1 : March of rainfall in various periods of onset.

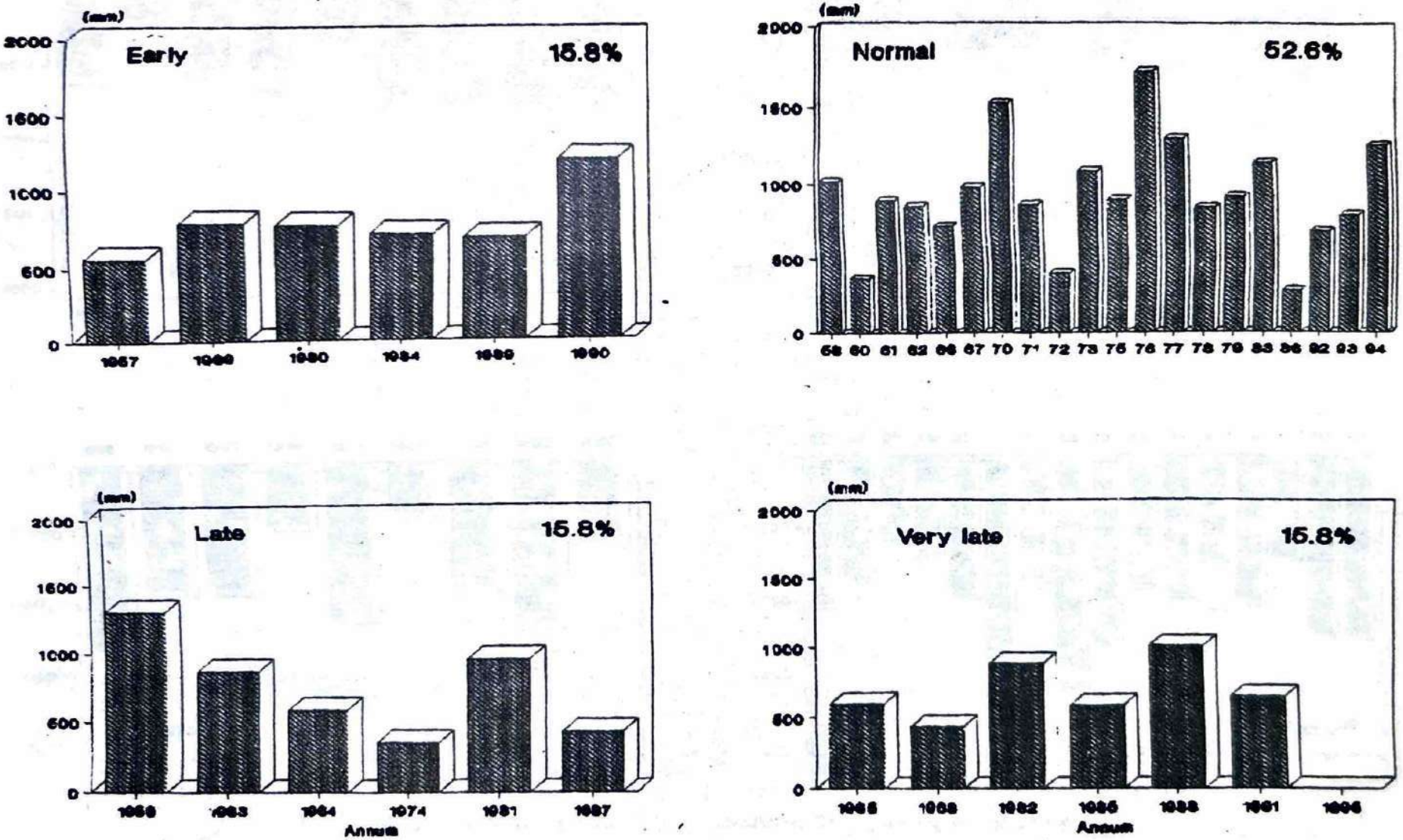
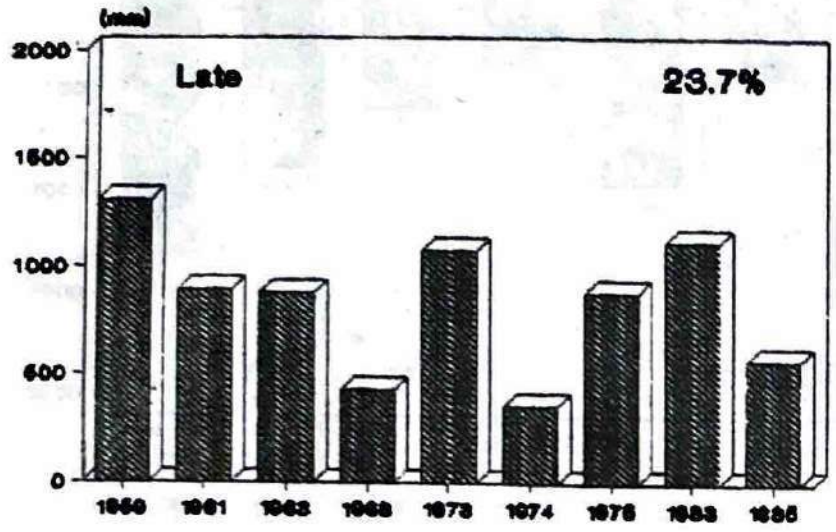
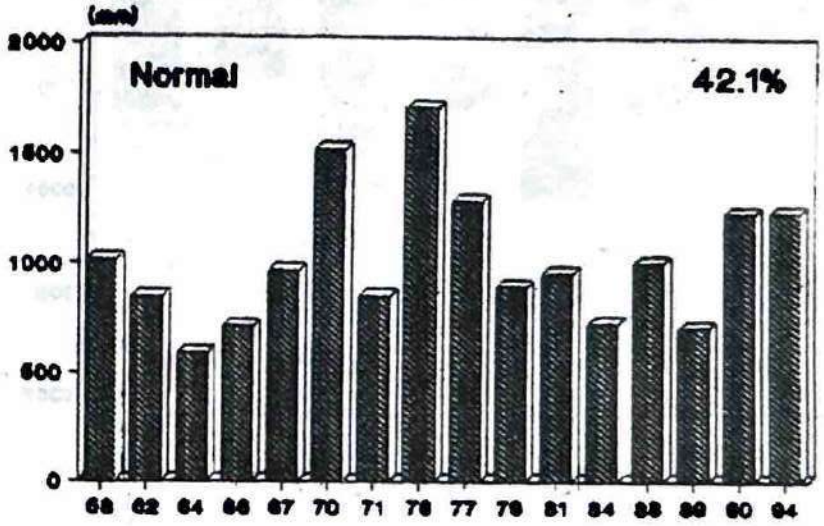
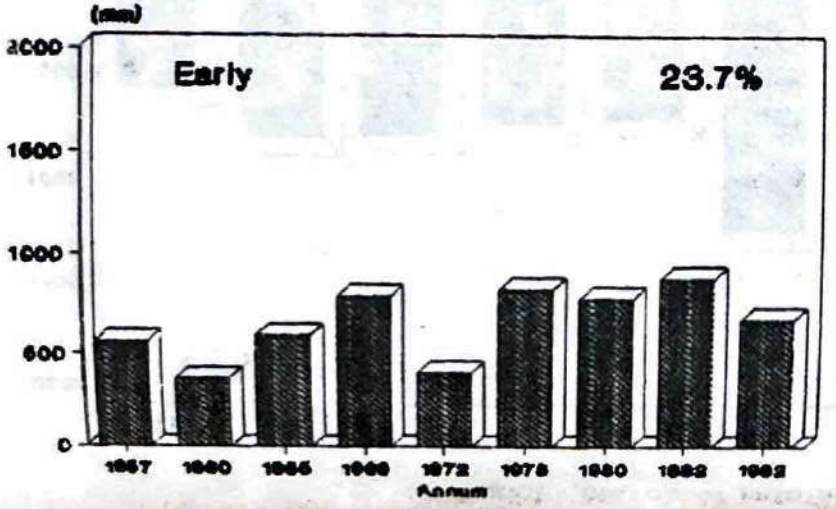


Fig. 2 : March of rainfall in various periods of withdrawal.







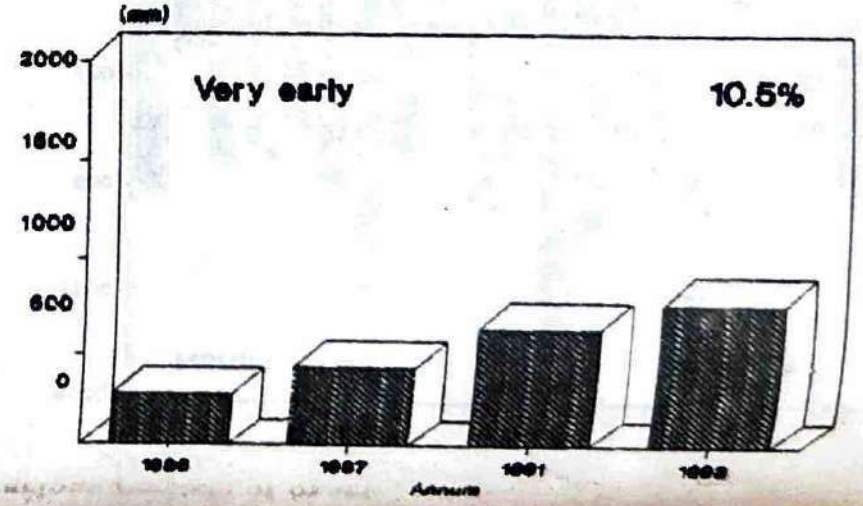


Fig. 3 : Comparative march of onset and withdrawal at Anand.

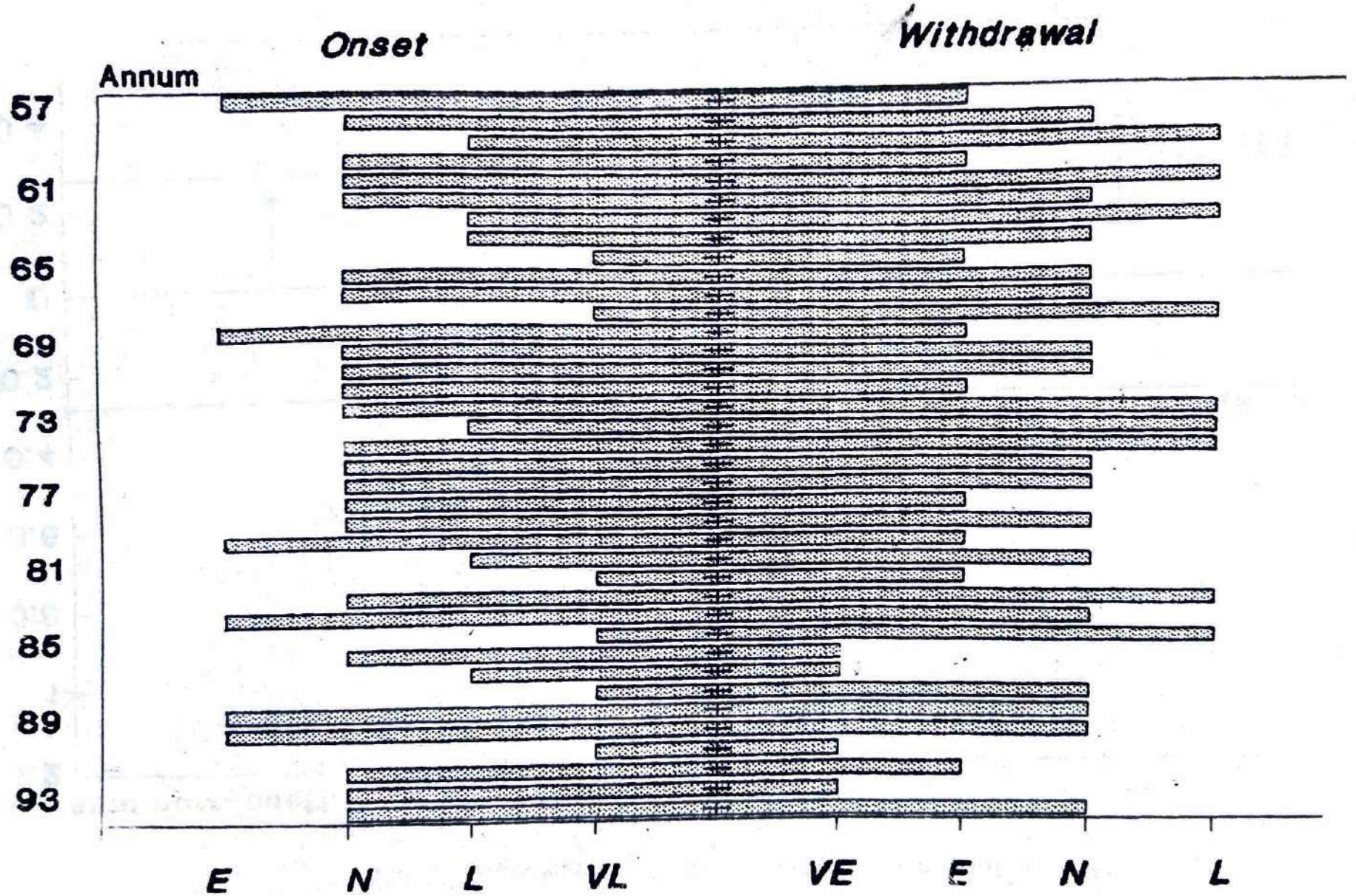


Fig. 4 : Correlogram of inter annual monsoon rainfall.

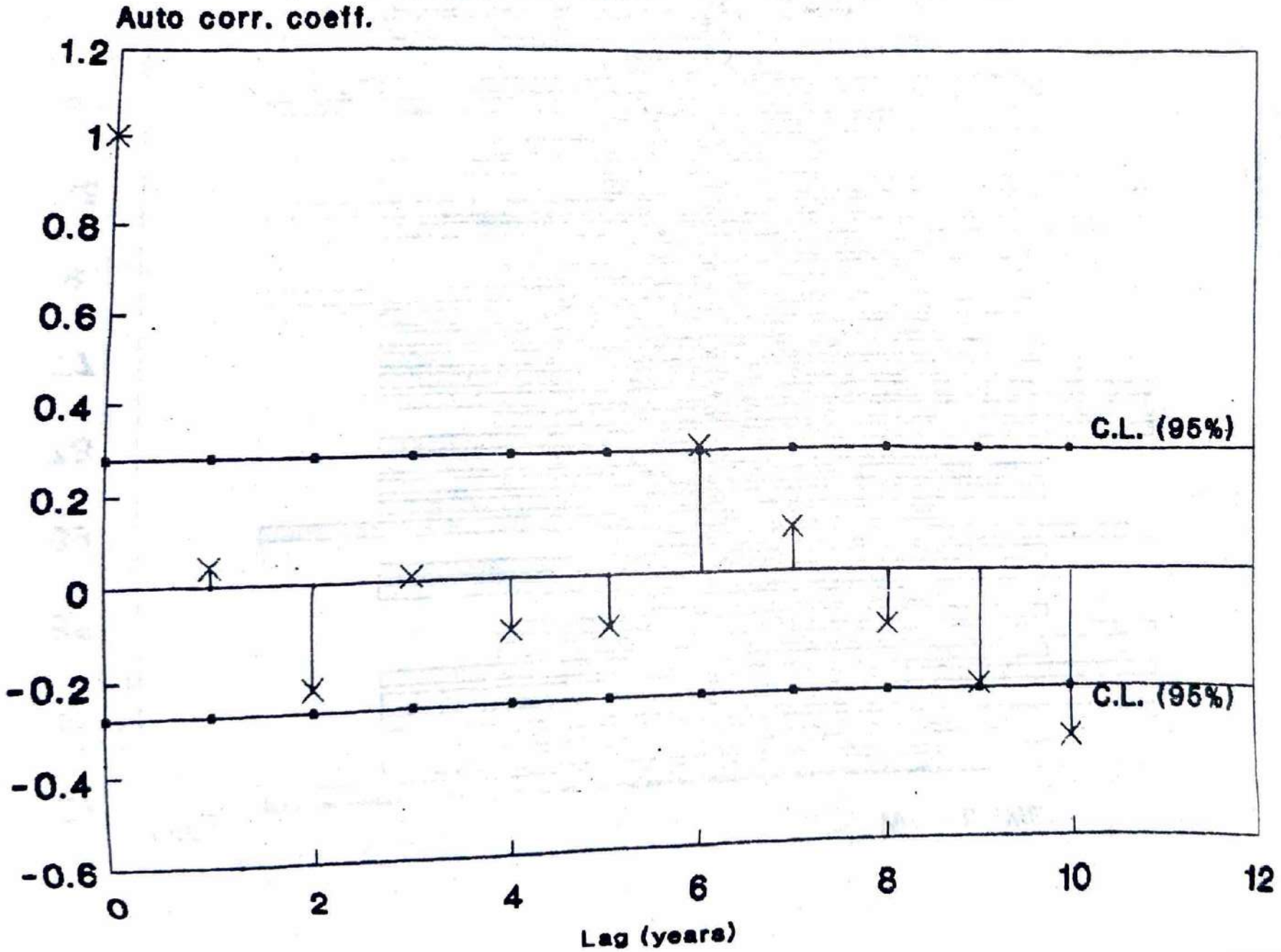


TABLE 2

Discriminability analysis of frequencies of different categories of onset and withdrawal of southwest monsoon at Anand (1957-94).

Onset	Withdrawal				Total
	Very early	Early	Normal	Late	
Early	0	3	2	0	5
Normal	2	5	10	4	21
Late	1	0	2	3	6
Very late	1	2	1	2	6
Total	4	10	15	9	38

Anova Table

Period	d.f.	Table 'F' at 1% level	S. Em.	Cal. 'F'	Test
Onset	3	6.99	14.75	4.12	NS
Withdrawal	3	6.99	5.08	1.42	NS
Error	9		3.58		

Interannual relationship of monsoon rainfall

The time series of monsoon rainfall at Anand has been studied for analyzing the inter-dependence of rainfall with those of the previous years. The auto correlation coefficient (r_k) at different lags (k) has been used for this purpose. The analysis showed positive (0.29) and negative (-0.39) significant relationships at six and ten years apart respectively, while the negative relationship at lag 9 (-0.27) was very close to the 95% level confidence limit (Fig. 4). Looking at the rainfall amounts in 1989 (706 mm), 1986 (286 mm) and 1985 (574 mm), which correspond to lags of 6, 9 and 10 years respectively, it may be inferred that Anand would not experience poor rainfall during 1995. Simple averaging of rainfall these three years gives a rainfall value of 522 mm for 1995. This is comparable with the actual rainfall (545.1 mm).

REFERENCES

Anonymous, (1988). Characterization of climate in relation to agricultural planning in Anand region. Research Bulletin Agromet No. 3.

Korin, B. P. (1977). Introduction to statistical methods. Winthorp Publ. Inc. Cambridge, Massachusetts.

Rao, Y. P. (1976). Southwest monsoon. Meteorological monograph : Synoptic Meteorology. No. 1/1976.

WMO (1971). Climate change. WMO-Tech. Note No. 79, Geneva.