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Rainfall probability analysis for crop planning in scarcity zone of Maharashtra

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ABSTRACT

Rainfall data of recent past 30 years (1966 to 1995) of Dry Farming Research Station, Solapur was analysed with the method of constant probability. The data revealed that the average rainfall of Solapur is 723.4 mm spread over 43 rainy days. Out of this 76 per cent is received from South-West monsoon season (June to September) and 15 per cent from North-East monsoon (October to December). The highest probability of receiving > 60 per cent rainfall can be expected only in 24th and 38th Meteorological Standard Weeks (MSW) which is helpful for sowing of *kharif* and *rabi* crops, respectively. For dry seeding of *kharif* crop 23rd MSW is suggested.

Key words: Crop planning, Rainfall probability, Maharastra

Rainfall is the single most important factor in crop production programme particularly under dryland areas. The annual, seasonal and monthly rainfall of a region is useful to design water harvesting structure. Similarly, weekly rainfall analysis gives more useful information for crop planning (Sharma *et al.*, 1979). Earlier workers have worked out the weekly rainfall probabilities for different agroclimatic regions (Ray *et al.* 1980 and Agnihotri *et al.*, 1986). Gupta *et al.* (1975) suggested that the rainfall at 80 per cent probability can safely be taken as sure rainfall, while that of 50 per cent probability is the medium limit for taking dry risk.

The rainfall of the study area is low, erratic and uncertain, with the highest peak occuring in the month of September (Patil and Kale, 1988) and hence, about 25 per cent area is cultivated during monsoon period and remaining in the post-monsoon period. Frequent dry spells are commonly experienced in the month of July and August and hence monsoon cropping becomes sometimes risky. Failure of rabi crop is also experienced due to early withdrawal of monsoon. Considering these problems under dryland situation and to identify the highest probability weeks for timely seeding of dryland crops the rainfall data was analysed.

MATERIALS AND METHODS

Rainfall data of recent past 30 years (1966 to 1995) of Solapur (17° 41' N, 75° 44' E and 479 m AMSL) have been analysed with the help of Weibulls formula as

$$P = [(m/n + 1) / 100]$$

where, P is plotting position in percentage, m is the rank of magnitude and n is number of years for which the data are taken. Rainfall at various probability levels (50, 60, 70, 80 and 90 per cent) for weekly, monthly, seasonal and annual trends have been worked out and are presented in Table 1 and 2. The monthly

coefficient of variations were also worked out and presented in Fig. 3.

RESULTS AND DISCUSSION

Analysis of rainfall data showed that on an average annual rainfall of the Solapur region is 723.4 mm received in 43 rainy days. The mean monthly rainfall of Solapur is 113.3, 127.7, 140.3 and 172.3 mm in the months of June, July, August and September, respectively with a total monsoon rainfall of 553.8 mm (Fig. 1). Seasonal rainfall for these months accounts for 76 per cent of the annual rainfall. The highest rainfall (172.5 mm) is received in the month of September (98 mm at 70 % probability) followed by July (88.6 mm at 70 % probability) (Table 1). Hence, July and September months are relatively suitable for water harvesting and recycling for scheduling a protective irrigation for winter crops under dryland situation. At 80 per cent probability the maximum rainfall of 12.7 mm is expected to be available in the 38th MSW. The seasonal distribution of rainfall data indicates that 461.2 mm could be expected at 70 per cent probability in south-west monsoon period, and 46.8 mm in north-east monsoon period.

The monthly coefficient of variation (CV) ranged between 55 to 226 per cent (Fig. 2). The weekly CV for *kharif* season (22 to 37 MSW) ranged between 87 to 155 per cent (Fig. 3), while that of *rabi* season (38 to 5 MSW) it ranged from 101 to 539 per cent. The high amount of rainfall i.e. 31.7, 18.4 and 33.0 mm was received in 24, 25 and 30 MSW with relatively lower CV (79 to 87 %) during *kharif* season. In *rabi* season, particularly in 38 and 40 MSW the rainfall was 49.4 and 33.2 mm, respectively with CV of 101 per cent.

The monthly analysis shows that at 70 per cent probability the rainfall amount ranging from 73 to 98 mm is expected during monsoon period (Table 1) and rainfall was highest (70.2 mm) even at 90 per cent probability levels in the month of September indicating September rainfall as more assured. Rainfall > 20 mm per week could be expected only at 60 per cent probability in MSW 24 and 38. Hence, for dry seeding 23 MSW may be preferred for this region and 24 MSW for normal sowing. The intermittent rains (> 10 mm per week) are also expected in MSW 25 to 32 (barring weeks 27 and 31), which also helps in growth of *kharif* crops. However, there are chances of dry spells (< 10 m rainfall per week) in MSW 25 to 39 and 31 to 36 at 70 per cent probability and hence the crops with staggered flowering like horsegram, mothbean, redgram be considered and also the intercropping system like pearl millet + redgram, sunflower + redgram for sustained production from drylands. During *rabi* season moisture situation is maintained from 38 MSW (24.2 mm at 60 % probability) followed by < 10 mm in 39 and 40 MSW ; therefore, rabi sowing of sorghum may be done in MSW 38 to harvest a good crop from drylands. Similarly, > 20 mm rainfall per week is observed in 37 to 40 MSW which supports this statement indicating minimum risk in *rabi* crops under dryland conditions.

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Table 1 : Monthly and seasonal expected rainfall amount (mm) at different probability levels at Solapur, Maharashtra

Months	Percentage				
	90 %	80 %	70 %	60 %	50 %
January	0.0	0.0	0.0	0.0	0.0
February	0.0	0.0	0.0	0.0	0.0
March	0.0	0.0	0.0	0.0	0.0
April	0.0	0.0	4.0	6.6	7.1
May	1.3	3.1	9.2	18.4	32.0
June	46.0	62.1	72.7	84.9	102.7
July	88.7	72.7	88.6	110.6	121.2
August	40.2	61.0	78.6	97.3	113.9
September	70.2	81.2	98.0	116.5	146.9
October	1.2	9.0	27.2	33.3	41.4
November	0.0	0.0	0.0	5.0	8.8
December	0.0	0.0	0.0	0.0	0.0
Season					
Hot weather (Mar-May)	3.6	9.5	20.8	39.7	55.9
SW monsoon (June-Sept.)	405.0	423.8	461.2	486.0	497.5
NE monsoon ()ct-Dec.)	35.4	41.4	46.8	51.6	66.0
Winter (Jan-Feb)	0.0	0.0	0.0	0.0	0.0

Table 2 : Expected weekly rainfall amount (mm) at different probability levels

Std. Met. Week	Dates	Percentage				
		90 %	80 %	70 %	60 %	50 %
1 to 21	1 Jan to 27 May	0.0	0.0	0.0	0.0	0.0
22	28-3 Jun.	0.0	0.0	2.8	6.5	7.6
23	4-10	0.0	3.0	7.0	11.2	17.9
24	11-17	0.0	3.3	12.0	20.6	27.9
25	18-24	0.0	2.9	4.0	13.6	18.0
26	25-1 July	0.0	1.7	3.3	10.1	12.9
27	2-8	0.0	2.0	3.0	6.3	6.8
28	9-15	0.0	0.0	2.0	11.3	14.1
29	16-22	2.0	5.0	7.0	14.0	16.9
30	23-29	0.0	8.4	16.3	19.5	27.8
31	30-5 Aug.	0.0	0.6	5.0	8.2	15.4
32	6-12	3.6	5.0	8.0	13.8	18.4
33	13-19	0.0	2.0	2.5	3.2	16.3
34	20-26	0.0	0.5	6.3	7.9	12.8
35	27-2 Sept.	0.0	2.0	6.7	10.8	15.0
36	3-9	0.0	0.0	2.2	5.3	7.2
37	10-16	0.0	0.0	0.0	3.5	24.6
38	17-23	0.0	12.7	16.6	24.2	38.2
39	24-30	0.0	2.0	7.2	1.3.	25.3
40	1-7 Oct.	0.0	0.0	1.8	18.4	28.5
41	8-14	0.0	0.0	0.0	0.0	1.0
42 to 52	15 Oct. to 31 Dec.	0.0	0.0	0.0	0.0	0.0

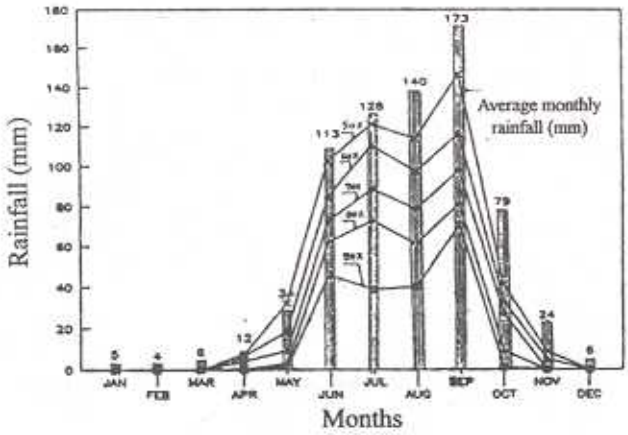

Fig.1: Monthly expected rainfall (mm) at different probability levels for solapur(M.S.)

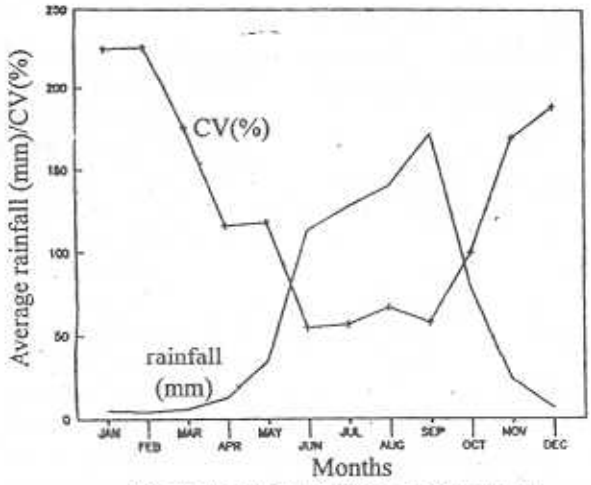

Fig.2: Monthly rainfall variation curve

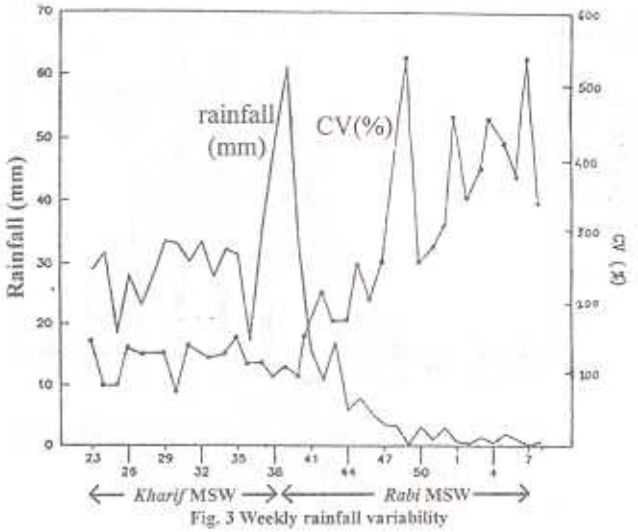

Fig. 3 Weekly rainfall variability

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