551.586 : 632.116 : 633.17

QUANTITATIVE ESTIMATION OF VARIATIONS IN SORGHUM YIELDS DUE TO RAINFALL IN A DRY FARMING REGION OF MAHARASHTRA

1. Rainfall plays a prominent role in the growth of crops, particularly, in areas where irrigation facilities are practically insignificant. Such areas, lying mainly in the Dry Farming Tract (DFT) of India, are characterised by annual rainfall ranging from 400 mm to 1000 mm. DFT stretches from north to extreme south running across 87 districts located in various States of India (Sarker *et al.* 1982). Kharif crops grown in this region are mainly dependent on rainfall during southwest monsoon season (June–September). The Dry Farming Region (DFR) of Maharashtra comprises of 12 districts in which kharif sorghum is grown as one of the major crops.

Studies concerning relationships between weather parameters, including rainfall and crop yields have been carried out by a number of workers (Das *et al.* 1971, Sreenivasan *et al.* 1973, Chowdhury and Sarkar 1981, Appa Rao and Dudhane 1984, Prasad and Dudhane 1989) by using multiple correlation and regression technique. In the present paper, similar method has been employed to investigate the influence of rainfall during monthly and cumulative periods,

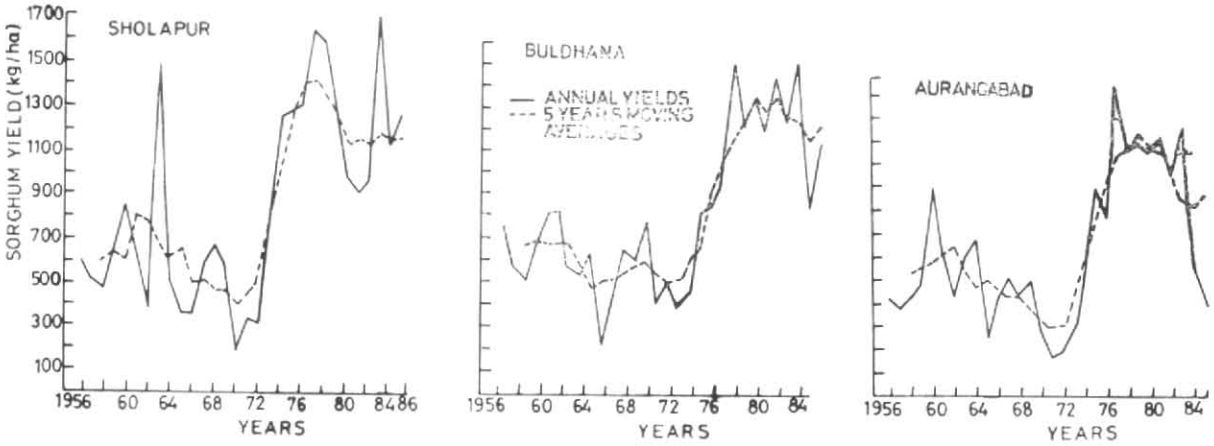

Fig. 1. Annual yields of sorghum of the districts under dry farming region of Maharashtra from 1956 to 1985 alongwith 5 years' moving averages

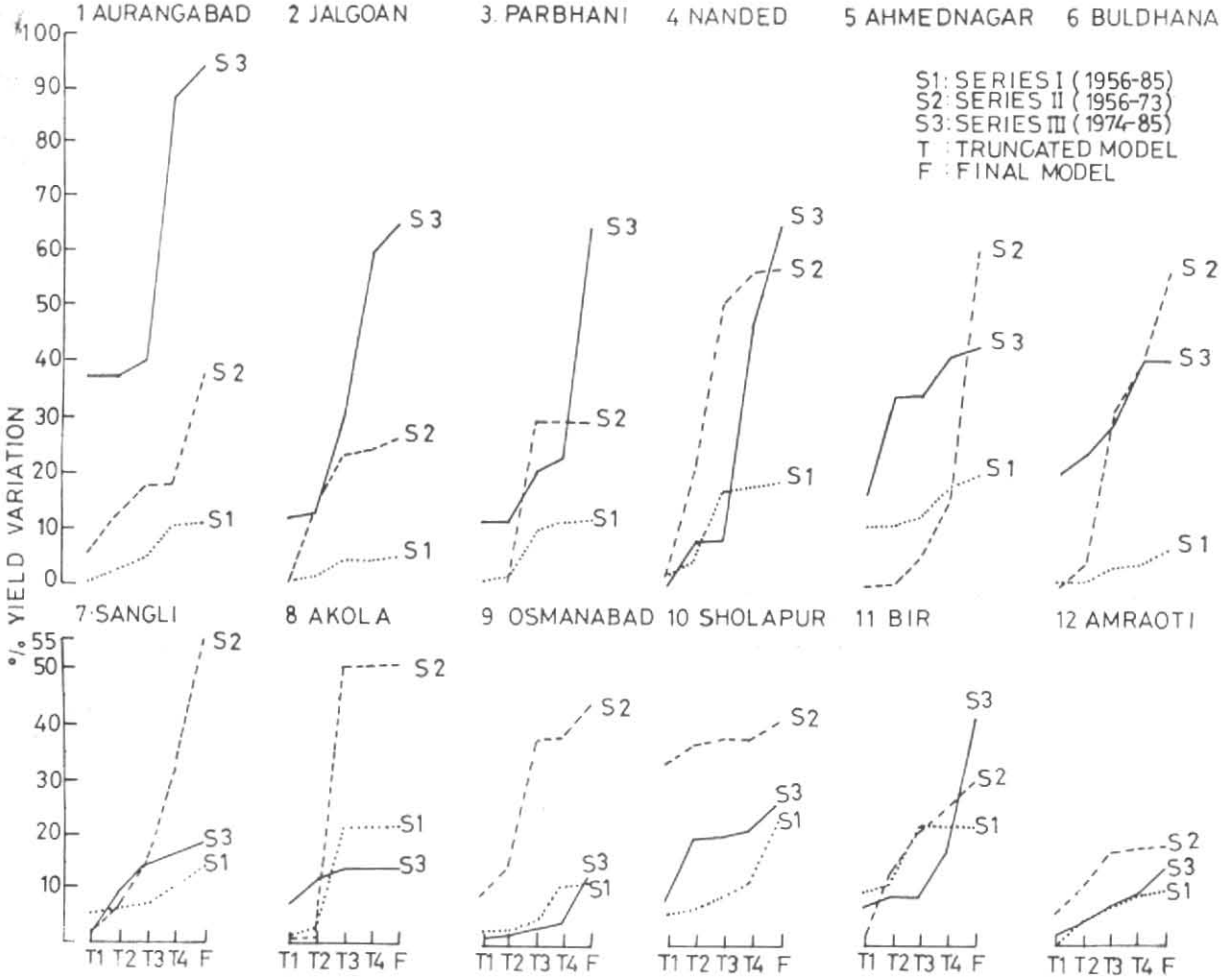

Fig. 2. Percentage variation of sorghum yields explained by the truncated as well as final models

TABLE 1

Final multiple regression models

S. No.	District	Final model	% Var.	MCC
		Series I (1956-85)		
1	Ahmednagar	$Y=497.61+3.56X_1-0.21X_2 -0.53X_3+1.39X_4+1.73X_5$	20	0.45
2	Sholapur	$Y=312.72+3.42X_1+0.04X_2 -0.98X_3+0.65X_4+2.23X_5$	23	0.47
3	Nanded	$Y=588.82+0.52X_1+0.46X_2 -0.61X_3+0.29X_4-0.33X_5$	18	0.43
4	Osmanabad	$Y=370.40+1.90X_1-0.35X_2 -0.35X_3+1.02X_4+0.22X_5$	11	0.33
		Series II (1956-73)		
1	Sangli	$Y=-25.58+0.67X_1+1.89X_2 +1.42X_3+1.67X_4+2.46X_5$	55	0.74
2	Nanded	$Y=316.38+0.97X_1+0.69X_2 -0.60X_3+0.53X_4-0.25X_5$	57	0.75
3	Buldhana	$Y=709.78+0.32X_1-0.19X_2 -1.22X_3+0.50X_4+1.01X_5$	58	0.76
		Series III (1974-85)		
1	Aurangabad	$Y=323.40+6.50X_1+0.27X_2 -1.61X_3+2.18X_4-2.79X_5$	93	0.97
2	Parbhani	$Y=1383.14-1.23X_1-0.19X_2 -1.05X_3+0.87X_4-2.59X_5$	65	0.80
3	Nanded	$Y=1471.77-2.07X_1+0.11X_2 +1.35X_3-2.12X_4-1.66X_5$	65	0.81

from June to October, on kharif sorghum yields in 12 districts in the DFR of Maharashtra. The main objectives of the present study are :

(a) To find the nature and degree of relationships between rainfall and sorghum yields,

(b) To estimate the quantum of contribution of monthly and cumulative rainfall from June to October on yield variations, and

(c) To establish statistically significant multiple regression models.

2. *Data and method*

The basic input data comprised of annual kharif sorghum yields (kg/hec) and monthly district average rainfall (mm) for five months from June to October, for a period of 30 years from 1956 to 1985, in respect of 12 districts under the DFR of Maharashtra. The yield data was obtained from Agricultural Situation in India and Season and Crop Reports published by the Economic and Statistical Adviser, Ministry of Agriculture, Government of India and the Director, Agriculture, Govt. of Maharashtra State respectively. Rainfall data was taken from the Hydrology Section of India Meteorological Department at Pune.

The present study is primarily based on the multiple correlation and regression technique by taking rainfall as independent and yield as dependent parameter. The method involves the development of truncated models corresponding to different phenological phases and the final models for the total crop growth period from June to October.

3. *Results and discussion*

3.1. *Yield analysis* — The mean standard deviation and coefficient of variations of sorghum yields of 12 districts under study were computed. Highest mean yields emerged in Ahmednagar followed by Jalgaon and Sangli. Districts with mean yields below 700 kg/hec were found to cluster together. Coefficient of variation in respect of about 70% districts exceeded 40% suggesting high variability in yield figures.

Annual yields of some typical districts, from 1956 to 1985, are shown in Fig. 1 alongwith 5 years' moving averages.

Following series were used in the regression analysis :

Series I : 1956-1985

Series II : 1956-1973 and

Series III : 1974-1985.

3.2. *Truncated models* — Fig. 2 shows the percentage variation of yields explained by the truncated as well as final models. It will be seen that variation of yields accounted for displays a gradual rise, obviously, as the cumulative periods progress forward extending from sowing to maturity. This appears in confirmity with crop phenology.

Series II models displayed encouraging improvement over series I. Models of series III accounted for higher variation in yields by as much as 88% and 60% at flowering stage for Aurangabad and Jalgaon with MCC as 0.94 and 0.77 respectively. Remaining districts could account for yield variation exceeding 25% and 40% at germination and elongation stages respectively.

Complete sets of truncated models were obtained for Bir (series I), Nanded (series II), Buldhana and Aurangabad (series III) which also accounted for highest yield variations at different stages of crop growth ranging upto 88% at flowering for Aurangabad (series III), 50% at elongation for Nanded (series II) and 37% at germination for Aurangabad (series III).

3.3. *Final models* — Table 1 shows final models for the three series. Final models based on series I, did not account for more than 23% variation in yield. However, models for series II explained over 50% variation

in yield in respect of Sangli, Nanded and Buldhana. Models for series III displayed remarkable improvement and the variation of yield accounted for Aurangabad, Parbhani and Nanded emerged as 93% and 65% each. Aurangabad explained highest variation in yield (Table 1).

Models developed for other districts are not significant at any standard level. This study has only been made to bring out statistical relationships between rainfall and sorghum yield and it is not aimed at developing crop yield forecasting models which are also based on other factors like the agricultural-technological trend. Still, this study has been able to highlight certain important results which have their own scientific value.

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