

A climatological study on double cropping under rainfed conditions in Bangalore region

B. V. RAMANA RAO, B. R. BIRADAR and Y. G. SAMPATH KUMAR

University of Agricultural Sciences, Bangalore

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ABSTRACT. The mean rainfall, the coefficient of variation, the probability of getting a dry week and the probabilities of the weekly rainfall exceeding 0.5, 1.0, 2.0, 3.0 and 4.0 cm during different weeks for the months April to December have been worked out using the rainfall data collected at Bangalore for the years 1921 to 1970. The periods from 16 May to 15 August and 16 August to 15 December were considered as the crop seasons for growing cowpea and ragi respectively. The rainfall distributions for the two crop seasons was compared with the rainfall distribution in the traditional crop growing season from 16 July to 15 November. The conditions by which two crops can be raised under rainfed conditions in Bangalore region has been discussed.

1. Introduction

The farmers in Bangalore region usually grow a single crop from the middle of July to November under rainfed conditions. Studies conducted by the Dry Land Research Centre in the University of Agricultural Sciences, Bangalore revealed the possibility of raising two crops under rainfed conditions (Anonymous 1976). It was suggested that cowpea can be sown in May which will be harvested by the middle of August and the second crop can be transplanted ragi of long duration which will be harvested in December, thereby the rainfall received from May to December can be fully utilised.

The present work was taken up to study the rainfall distribution for the two crop seasons under double cropping and to compare with that of the rainfall distribution for the traditional crop growing season.

2. Material and methods

The daily rainfall data recorded at the Central Observatory, Bangalore for the years 1921 to 1970 were analysed weekwise for the months April to December. Each month was divided into four weeks as shown below and the weeks are serially numbered from 1 to 36 for the months April to December.

| Months | Week number | Dates |
|-------------------|-------------|-------------|
| April to December | 1 | 1-8 |
| | 2 | 9-15 |
| | 3 | 16-23 |
| | 4 | 24-30 or 31 |

The mean weekly rainfall, the coefficient of variation of weekly rainfall (ratio of standard deviation to mean expressed in per cent), the probability of a week with zero rainfall were calculated for different weeks. The probabilities of weekly rainfall exceeding 0.5, 1.0, 2.0, 3.0 and 4.0 cm during different weeks were calculated using the tables for application of gamma distribution model to rainfall prepared by Moolley (1974). The rainy periods from third week of May to second week of August with a total average rainfall of 32.2 cm and from third week of August to the second week of December with a total average rainfall of 46.8 cm were considered as the crop seasons for double cropping under rainfed conditions. The percentage departures of the actual seasonal rainfall from the mean rainfall were calculated for different years for both the seasons. The period from the third week of July to the second week of November with an average rainfall of 55.3 cm was considered as the traditional cropping season and the percentage departure of the actual seasonal rainfall from the mean seasonal rainfall was also calculated for different years.

3. Results and discussion

The mean weekly rainfall, the coefficient of variation and the probability of getting a dry week during different weeks for the months April to December are shown in Fig. 1(a). The probabilities for the weekly rainfall exceeding 0.5, 1.0, 2.0, 3.0 and 4.0 cm during different weeks for the months April to December are shown in Fig. 1(b). The mean weekly rainfall and the coefficient of variation of weekly rainfall

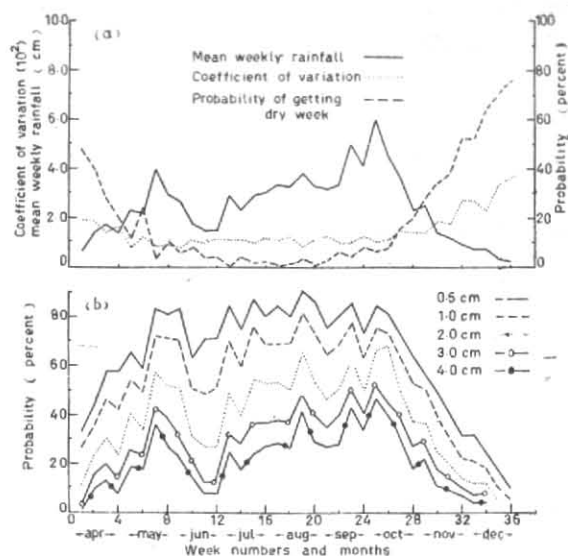


Fig. 1

- (a) The mean weekly rainfall, coefficient of variation and probability of getting a dry week at Bangalore
 (b) The probabilities of weekly rainfall exceeding different selected amounts

TABLE 1

Mean weekly rainfall and coefficient of variation of weekly rainfall during different weeks considered from April to December

| Week No. | Mean weekly rainfall (cm) | Coefficient of variation (percentage) |
|----------|---------------------------|---------------------------------------|
| 1 | 0.67 | 187 |
| 2 | 1.31 | 188 |
| 3 | 1.66 | 142 |
| 4 | 1.37 | 161 |
| 5 | 2.25 | 80 |
| 6 | 2.19 | 128 |
| 7 | 3.98 | 89 |
| 8 | 3.00 | 93 |
| 9 | 2.74 | 82 |
| 10 | 1.83 | 113 |
| 11 | 1.50 | 100 |
| 12 | 1.50 | 105 |
| 13 | 2.88 | 106 |
| 14 | 2.33 | 107 |
| 15 | 2.85 | 95 |
| 16 | 3.04 | 118 |
| 17 | 3.25 | 114 |
| 18 | 3.29 | 122 |
| 19 | 3.84 | 84 |
| 20 | 3.25 | 111 |
| 21 | 3.15 | 116 |
| 22 | 3.29 | 104 |
| 23 | 5.04 | 101 |
| 24 | 4.13 | 116 |
| 25 | 6.03 | 99 |
| 26 | 4.47 | 109 |
| 27 | 3.86 | 128 |
| 28 | 2.26 | 138 |
| 29 | 2.46 | 141 |
| 30 | 1.39 | 178 |
| 31 | 1.19 | 173 |
| 32 | 0.87 | 274 |
| 33 | 0.71 | 261 |
| 34 | 0.67 | 225 |
| 35 | 0.30 | 333 |
| 36 | 0.14 | 357 |

during different weeks are also given in Table 1. If it is assumed that the rainy season available for crop growth commences from the week when (i) the mean weekly rainfall is more than 2.5 cm; (ii) the coefficient of variation is less than 100 per cent, (iii) the probability of that particular week remaining as dry is less than 10 per cent and (iv) the probability of getting a rainfall exceeding 2.0 cm is more than 55 per cent. Similarly the rainy season available for crop growth terminates after the third week of October when the mean weekly rainfall decreases, the coefficient of variation increases, the probability of getting a dry week increases and the probability of the weekly rainfall exceeding 2.0 cm starts decreasing. During the period from the third week of May to the third week of October, there would be considerable moisture stress in the second, third and fourth weeks of June when the probability of the weekly rainfall exceeding 1.0 cm is just 50 per cent. The uncertainty of the rainfall beyond the third week of October is also well indicated due to the increase in coefficient of variation, the probability of getting a dry week and decrease in the mean weekly rainfall and the probability of the weekly rainfall exceeding 2.0 cm. Therefore the first crop of cowpea will in general experience moisture stress during the second, third and fourth weeks of June. The second crop of ragi which will be of about 60 to 70 days old may also suffer due to uncertainty of rainfall beyond the third week of October whereas under the traditional practice of growing ragi, the crop which will be about 100 days old by the third week of October

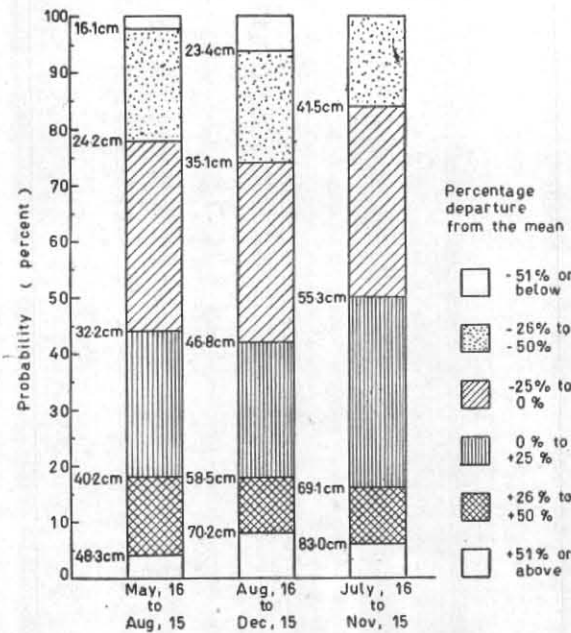


Fig. 2. Percentage departure from the mean seasonal rainfall and its probability during both the seasons under double cropping and the traditional cropping seasons

TABLE 2

Rainfall distribution at 5 per cent intervals for the percentage departure from the mean rainfall during different crop seasons considered

| Percentage departure from mean seasonal rainfall | Amount of rainfall (in cm) during different crop seasons under | | |
|--|--|------------------|-----------------------------|
| | Double Cropping | | Traditional single cropping |
| | 16 May to 15 Aug | 16 Aug to 15 Dec | (16 July to 15 Nov) |
| -50 | 16.10 | 23.40 | 27.65 |
| -45 | 17.71 | 25.74 | 30.42 |
| -40 | 19.32 | 28.08 | 33.18 |
| -35 | 20.93 | 30.42 | 35.95 |
| -30 | 22.54 | 32.76 | 38.71 |
| -25 | 24.15 | 35.10 | 41.48 |
| -20 | 25.76 | 37.44 | 44.24 |
| -15 | 27.37 | 39.78 | 47.01 |
| -10 | 28.98 | 42.12 | 49.77 |
| -5 | 30.59 | 44.46 | 52.54 |
| 0 | 32.20 | 46.80 | 55.30 |
| + 5 | 33.81 | 49.14 | 58.07 |
| +10 | 35.42 | 51.48 | 60.83 |
| +15 | 37.03 | 53.82 | 63.60 |
| +20 | 38.64 | 56.16 | 66.36 |
| +25 | 40.25 | 58.50 | 69.13 |
| +30 | 41.86 | 60.84 | 71.89 |
| +35 | 43.47 | 63.18 | 74.66 |
| +40 | 45.08 | 65.52 | 77.42 |
| +45 | 46.69 | 67.86 | 80.19 |
| +50 | 48.30 | 70.20 | 82.95 |

may not suffer due to uncertainty of rainfall beyond the third week of October.

The amounts of rainfall calculated for different departures from the mean rainfall at 5 per cent intervals during both the crop seasons under double cropping and the traditional single crop season are given in Table 2. Fig. 2 shows the percentage departure from the mean seasonal rainfall and its probability during both the seasons under double cropping and the traditional cropping season represented by the bar diagrams. The amounts of rainfall corresponding to the different levels of departure from the mean rainfall are also indicated adjacent to the bar diagrams. A comparative study of the bar diagrams for the second crop season from 16 August to 15 December and the traditional single crop season from 16 July to 15 November reveals that the rainfall is more assured in the traditional cropping season from the middle of July to middle of November having a probability of 84 per cent for getting rainfall of 41.5 cm whereas the rainfall will be about 30 cm with 84 per cent probability during the second crop season under double cropping from the middle of August to middle of December.

The correlation coefficient between the rainfall during both the seasons under double cropping is found to be -0.83 and it is significant at 5 per cent level.

When the actual seasonal rainfall is below the mean seasonal rainfall, it was considered as deficit season and when the actual seasonal rainfall

TABLE 3

The probabilities of getting surplus (S) and deficit (D) of rainfall during both the crop seasons under double cropping at Bangalore

| The combination of surplus or deficit of rainfall in the first crop season with surplus or deficit in the second season | Probability (%) |
|---|-----------------|
| (D, D) | 28 |
| (D, S) | 28 |
| (S, D) | 28 |
| (S, S) | 16 |

is above the mean seasonal rainfall, it was considered as surplus season. Table 3 shows deficit (D) and surplus (S) of the seasonal rainfall for both the crop seasons under double cropping with associated probabilities, (D, D), (D, S), (S, D) and (S, S) indicate the combination of deficit rainfall in both the seasons, deficit in the first season and surplus in the second season, surplus in the first season and deficit in the second season and surplus in both the seasons respectively. The probability for rainfall to be surplus in both the seasons under double cropping is only 16 per cent and the probability for the surplus of rainfall during the second crop season is 44 cent. As ragi is considered as the important and main crop of this region, there seems to be more risk for ragi crop grown during the second crop season under double cropping. To minimise this risk, ragi should be sown in the third week of July in nurseries and transplan-

tation of ragi should be taken up during the third week of August immediately after harvesting the first crop of cowpea. This arrangement will fit the second crop of ragi in the traditional season from July to November. The other alternative will be to develop a short duration ragi which can be sown in the third week of August. Harvesting and conservation of the excess rainwater received particularly during second fortnight of May will be of use for the first crop of cowpea during the critical period of moisture stress in the second, third and fourth weeks of June. Similarly harvesting and conservation of excess rainwater during September and beginning of October months will be of great use when the rainfall is uncertain beyond the third week of October.

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