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Commencement of growing season and productivity of groundnut in Rajkot district

N. N. SRIVASTAVA, U. S. VICTOR and B. V. RAMANA RAO

Central Research Institute for Dryland Agriculture, Hyderabad

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सार — गुजरात राज्य के राजकोट जिले में मूंगफली के निम्न उत्पादन के खतरे का पता लगाने के लिए जल की आवश्यकता संतुष्टि सूचकांक के संबंधमें फ्रेरे और पोपोव की धारणा का प्रयोग किया गया। सन् 1974 से 1984 ई. तक मूंगफली का औसत उत्पादन 720 कि. ग्रा./है. था यह देखा गया कि इन वर्षों के दौरान उत्पादन औसत से भी कम हुआ। जल की आवश्यकता संतुष्टि सूचकांक 81 प्रतिशत से कम थी। 2 जुलाई के बाद वर्धन काल के आरम्भ में विलम्ब के कारण निम्न औसत उत्पादन का खतरा बढ़ा।

ABSTRACT. Frere and Popov's concept of water requirement satisfaction index was utilized to determine the risk of low productivity of groundnut in Rajkot district of Gujarat State. The average productivity of groundnut for the years 1974 to 1984 was 720 kg/ha. The productivity was observed to be less than average during the years with water requirement satisfaction index below 81 per cent. The risk of below average production increased with delay in commencement of growing season beyond 2 July.

1. Introduction

Groundnut (*Arachis Hypogea* L.) is grown under rainfed conditions in nearly 4 lakh hectares in Rajkot district, which contributes 19.2 per cent of the production in Gujarat. Srivastava *et al.* (1987) identified conditions under which the productivity of groundnut will be below average during some of the years on the basis of ratio of actual evapotranspiration to the potential evapotranspiration using Thornthwaite and Mather's water balance approach. Frere and Popov (1979) and Popov (1982) demonstrated the relationship between the Water Requirement Satisfaction Index (WRSI) and the yield of groundnut at Bambey, Senegal. The present exercise was undertaken to identify the production constraints of groundnut in Rajkot district using WRSI.

2. Material and methods

The area and production of groundnut in Rajkot district for the years 1974 to 1984 were taken from the *Agricultural Situation in India* published by the Ministry of Agriculture, Government of India. The weekly totals of rainfall for 1901-84 period were used. The normal monthly potential evapotranspiration values calculated by Rao *et al.* (1971) were utilized and the weekly values were graphically interpolated. Sowing is assumed to take place during week with rainfall more than 50 mm from 24th standard meteorological week. The growth period is taken as 15 weeks, since bunch type groundnut is grown. The weekly water balance computations are carried out using the soil water balance model of Frere and Popov (1979). The available water holding capacity of the soil is taken as 100 mm, as the soils in Rajkot district are shallow to medium sandy clay loams with soil depth ranging from few to 60 cm (Anonymous 1983). Yearwise WRSI values were calculated for each growing season. Then, the optimum value of WRSI below which the yield of groundnut will be less than the average was obtained by using the technique proposed by Azzi (1956).

The groundnut crop is considered to be in vegetative phase from 1st to 3rd week, flowering phase from 4th to 6th week, pegging and pod development 7th to 12th week and maturity from 13th to 15th week of its growth cycle. For peg penetration and pod development, the soil should be well drained, loose and friable. Hence, sandy loamy soils rich in organic matter are suitable. Emergence of groundnut seedlings will be affected when the temperature of the top 10 cm of soil is below 18°C (Vishnumurthy 1985). Optimum temperature for vegetative growth is between 27°C and 30°C depending on

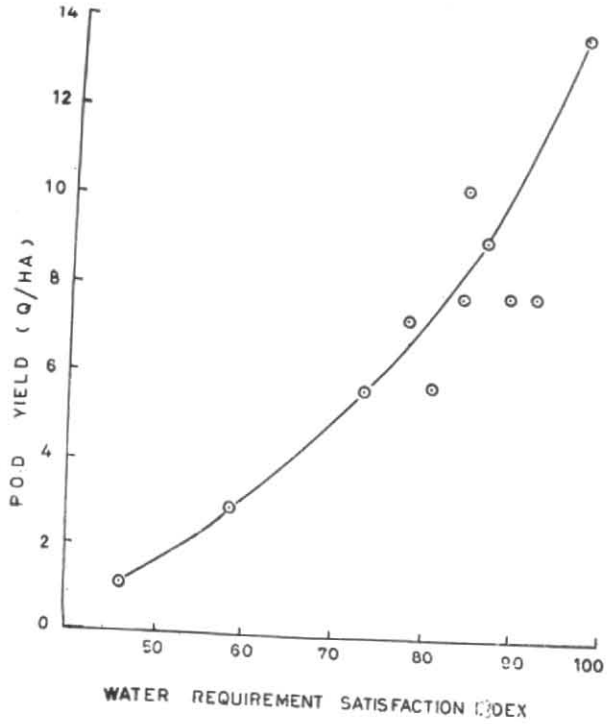

Fig. 1. Productivity of groundnut as related to water requirement satisfaction index in Rajkot district

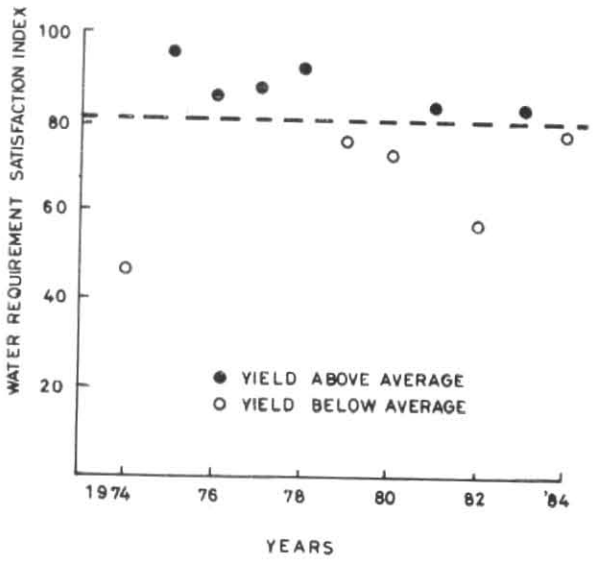

Fig. 2. Water requirement satisfaction index during different years

TABLE 1

Effect of commencement of growing season (1901-84) on getting below optimum water requirement satisfaction index during different phenophases of groundnut

Week of commencement of growing season	No. of years of occurrence	No. of years with W.R.S.I. falling below optimum value during phases			
		Flowering	Pegging & pod development	Maturity	Total
24	16	1	3	2	6
25	21	1	4	2	7
26	15	—	4	1	5
27	17	—	6	4	10
28	8	—	3	2	5
29	4	—	2	2	4
30	1	—	1	—	1
31 and onwards	2	—	2	—	2
Total	84	2	25	13	40

TABLE 2

Effect of commencement of growing season (1901-84) on possible productivity of groundnut

Commencement of growing season	No. of years of occurrence	Average W.R.S.I.	Probability of getting pod yield	
			Above average	Below 75% of the average
24-26th weeks	52	82.5	65.4	23.1
27-28th weeks	25	70.7	40.0	48.0
29th week onwards	7	52.8	0.0	100.0

the cultivar and reproductive growth is found to be good at temperatures between 24°C and 27°C (Vishnumurthy 1985).

3. Methodology

The cumulative water balance is based on weekly values of precipitation and potential evapotranspiration. Simply, it is the difference between the precipitation received by the crop and the water lost by the crop and soil through transpiration and evaporation. A negative value of precipitation *minus* water requirement of the crop indicates the amount by which the precipitation fails to supply the water requirement of the crop. Then the deficit refers to the shortfalls in the water requirement after taking the soil moisture into consideration. A positive value indicates the amount of excess water which is available for (*i*) soil moisture recharge in the root zone and (*ii*) moisture surplus after the recharge of the soil up to selected water retention capacity level.

4. Water requirment satisfaction index

The index indicates in percentage the extent to which the water requirements of an annual crop have been satisfied cumulatively at any stage of its growth cycle.

The index is assumed to be 100 at the beginning of the crop growing season as the sowing takes place when there is adequate water in the soil. This index will remain at 100 for the successive weeks until either a water stress or water logging occurs. In this approach the productivity is considered to be adversely affected not only due to moisture deficits but also because of excessive moisture reducing soil aeration which in turn affects pod development. In this study, it is assumed that if a surplus of more than 100 mm occurs during a week and the rainfall during the same week has fallen in less than 3 days, the index is reduced by 2.1 units during the week. If a deficit occurs, then the percentage ratio of the water deficit and the total water requirement of the crop is calculated and is subtracted from the index value obtained at the end of the preceding week. The calculation is pursued to the end of the growing season.

5. Results and discussion

The average weekly rainfall is 20 mm or more during the period from 24th to 37th week (11 June to 16 September). Coefficient of variation of weekly rainfall based on the data from 1901 to 1984 is high and ranged between 128.7 and 621.5 per cent which signifies the uncertainty of rainfall during the rainy season. Fig. 1 shows the association between the WRSI and productivity (kg/ha) of groundnut in the district. The average productivity of groundnut for the years 1974-84 was found to be 720 kg/ha. Fig. 2 indicates the optimum value of WRSI to obtain average productivity of groundnut as 81 per cent. The effect of commencement of growing season during different weeks of number of years with WRSI falling below the optimum value during different phenophases of crop growth are given in Table 1. The growing season was found to commence from 24th to 26th week in 52 years out of which the WRSI was below optimum in 18 years. The WRSI was below optimum in 15 out of 25 years with commencement of growing season during 27th and 28th weeks and during all the remaining seven years during which the commencement of growing season was delayed beyond 28th week. The index was found to be (*i*) less than optimum value in 40 out of 84 years and (*ii*) falling below optimum value during pegging and pod development stage itself in 25 out of 40 such cases. Therefore, the risk of getting below average productivity increases with delay in the commencement of growing season as summarised and given in Table 2. The productivity of groundnut can be expected to be less than 75 per cent of the average during the years with WRSI below 72.5 per cent (Fig. 1). The WRSI was found to be less than 72.5 per cent in 48 and 100 per cent of the years with commencement of the growing season from 27th to 28th week and 29th week onwards respectively.

Decadal frequencies of occurrence of years with below optimum WRSI are worked out. It is seen that WRSI was below optimum for a maximum of 7 years during

the decade 1901-10 and for a minimum number of 3 years during the decade 1971-80. Frequencies of occurrence of years with WRSI below optimum for consecutive years are also computed. It is observed that WRSI was below optimum for a maximum of 5 consecutive years on two occasions, *i.e.*, 1901-05 and 1965-69. Similarly frequencies of 2 and 3 such consecutive years were found to be 3 and 4 respectively.

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