

A study on water consumption, water use efficiency and crop coefficient of groundnut

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सार – वर्ष 1994 से 1996 तक खरीफ की फसल के दौरान किए गए प्रयोगों से प्राप्त किए गए आँकड़ों का उपयोग करते हुए समय के साथ मूंगफली के फसल गुणांक को बताने के लिए एक निदर्श विकसित किया गया है। बीच बोने के दसवें सप्ताह में फसल गुणांक का चरम मान 1.07 पाया गया है। मूंगफली की फसल के लिए औसत जल उपयोग और जल उपयोग की क्षमता क्रमशः 315.6 मि. मी. और 4.22 कि.ग्रा./हे./मि. मी. पाई गई है।

ABSTRACT. A model has been developed for relating crop coefficient of groundnut with time using the data generated by an experiment conducted during kharif 1994 to 1996. The peak value of crop co-efficient was found to be 1.07 on 10th week after sowing. The average water use and water use efficiency for groundnut crop are found to be 315.6 mm and 4.22 kg/ha/mm respectively.

Key words – Groundnut, Actual evapotranspiration, Crop coefficient, Water use efficiency.

1. Introduction

Among oil seeds in India, groundnut (*Arachis hypogaea*) accounts for about 50% of area and 45% of oil production. In India, about 75% groundnut area lies in low to moderate rainfall zone. Most of the groundnut production is concentrated in five states, viz., Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra.

Evapotranspiration from soil and plant surfaces, commonly known as evapotranspiration, is a primary component of the energy exchange function and determines the production potential of the crop species and the distribution of natural vegetation. It is highly correlated with net productivity. Knowledge of crop coefficient (Kc) is required to optimize the water requirement during the various stages of growth period. Doorenbos and Pruitt (1977) showed the significance of Kc for assessment of crop water requirement for irrigation scheduling. Gadgil *et al.* (2002) studied the appropriate strategies for cultivation of rainfed groundnut in the Anantapur region in a semiarid part of Indian peninsula. However, the exact need of the groundnut is not yet worked out under eastern dry agroclimatic zone of Karnataka state. Such knowledge is essential for irrigation scheduling and crop water requirement. In the present

study an attempt was made to develop regression equation relating crop coefficient (Kc) with time and to determine Water Use Efficiency (WUE).

2. Data and methodology

In the present study, data on the groundnut of variety JL-24 grown at Agro meteorological Research Unit of IMD at GKVK Campus, Bangalore (12° 58' N, 77°35' E, 0930 m asl) in Karnataka State for the three years during Kharif season between (1994-1996) were analyzed to study crop coefficient and water use efficiency.

The crop was raised on red sandy loam soils following the recommended package of practices of University of Agricultural Sciences, Bangalore.

The crop coefficient (Kc) was calculated using following relationship

$$Kc = AET/PET$$

Potential evapotranspiration (PET) values are calculated using Penman's modified formulae. The data on Meteorological parameters from adjacent agrometeorological observatory was used. The actual

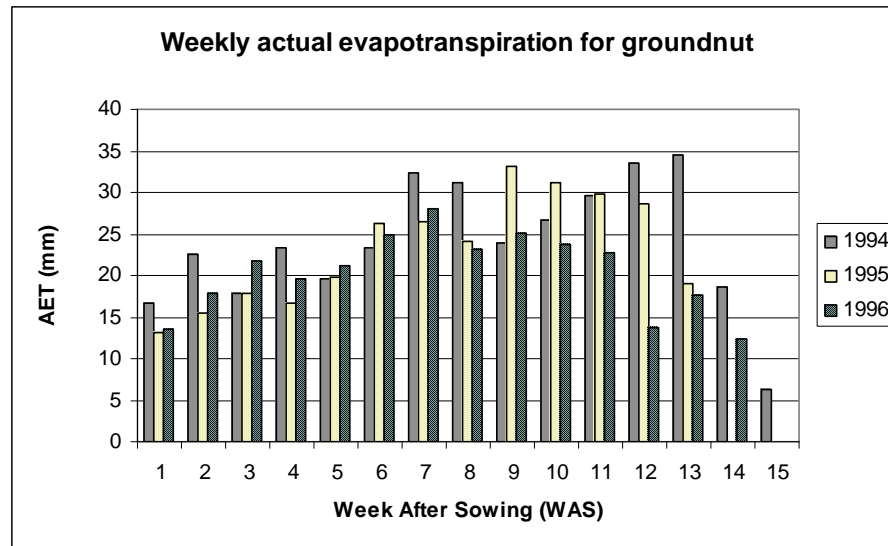


Fig. 1. Weekly actual evapotranspiration for groundnut for the years 1994, 1995 and 1996

TABLE 1

Crop yield, water use and water use efficiency

Year	Date of sowing	Date of physiological maturity	Yield (kg/ha)	AET (mm)	WUE (kg/ha/mm)
1994	01 Aug 1994	07 Nov 1994	1456	360.2	4.04
1995	24 Jul 1995	19 Oct 1995	1380	301.4	4.57
1996	21 Aug 1996	26 Nov 1996	1156	285.4	4.05
		Mean		315.6	4.22

evapotranspiration (AET) was measured through gravimetric lysimeters located in the crop field during the years (1994-1996).

3. Results and discussion

3.1. Water use and water use efficiency

Total mean actual evapotranspiration from sowing to physiological maturity of the groundnut crop was 315.6 mm (Table 1). The peak value of crop coefficient was 1.07 on 10th week after sowing. The rainfall was 1.4 mm on 10th week after sowing during 1996 whereas the rainfall was 19.4 mm and 36.2 mm on 10th week after sowing during 1994 and 1995 respectively. Because of this comparatively low rainfall on 10th week after sowing during 1996, there might be soil moisture stress. Therefore

the total actual evapotranspiration value is comparatively less during 1996. In a similar study, Idinoba *et al.* (2008) determined the total mean evapotranspiration of 302.5 mm for groundnut at the International Institute of Tropical Agriculture, Ibadan. The difference in water consumption is as a result of several reasons, amongst them the important ones are; varietal differences, changing evaporative demands of the atmosphere especially with respect to the controlling factor of insolation and difference in soil characteristics influenced by local conditions. Total water use values of groundnut crop reported in literature and summarized by Sivakumar and Sharma (1986) indicate that it ranges from 250 to 831 mm reflecting variability in soil climatic conditions and varieties used. The weekly actual evapotranspiration recorded during 1994, 1995 and 1996 in the present study are shown in Fig. 1 from which it can be seen that the

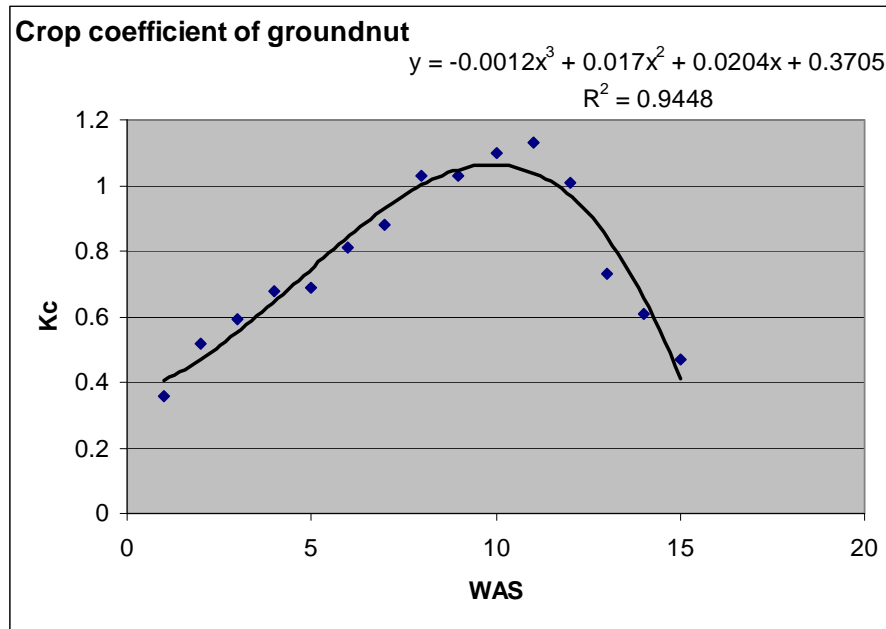


Fig. 2. Crop coefficient of groundnut during 1994-1996

water consumption is maximum during pod development stage across all the years. The average water use efficiency was found to be 4.22 kg/ha/mm (Table 1). Rathore (1989) reported WUE of 3.99 kg/ha/mm for groundnut of variety JL-24 at Rajkot.

3.2. Crop coefficient

The knowledge of crop co-efficient is necessary to determine water requirement of the crop. Fig. 2 shows variations in crop coefficient (Kc) with time, in weeks after sowing (WAS) during the growth of groundnut. When Kc values were fitted to time in WAS, the following nonlinear relationship ($R^2 = 0.94$) was obtained.

$$Kc = 0.3705 + 0.0204 X (WAS) + 0.017 X (WAS)^2 - 0.0012 X (WAS)^3, \quad R^2 = 0.94$$

Using this equation, it is possible to estimate Kc values at any time during different stages of crop growth. The peak value of crop coefficient was 1.07 on 10th week of sowing. The values of Kc fall substantially at the time of maturity due to senescence which reduces transpiration. The values of Kc determined for groundnut by Chaudhari *et al.* (1999) are 0.65, 1.15 and 0.85 during emergence to flowering, pegging & pod development and physiological maturity respectively. Tiwari *et al.* (2005)

reported the average values of Kc for initial growth stage, flowering & pegging stage, pod development stage and ripening stage to be 0.38, 0.86, 1.24 & 0.79 respectively. The change in value of crop coefficients could be due to differences in crop variety, sowing date, rate of crop development, length of growing seasons and climatic conditions at the different locations.

4. Conclusions

- (i) The average water use and water use efficiency for groundnut crop in Bangalore are found to be 315.6 mm and 4.22 kg/ha/mm respectively.
- (ii) A regression equation was fitted between Kc and weeks after sowing. This can be used for calculating the crop co-efficient at any time after sowing.
- (iii) The peak value of crop co-efficient was 1.07 around 10th week after sowing.

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