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**A STUDY ON WATER REQUIREMENT DURING
GROWTH OF WHEAT (*TRITICUM AESTIVUM*. L.)
AT VARANASI**

1. In the present study data on wheat crop (cv. *malviya-234*) grown at Auxilliary Evapotranspiration

Observatory, Varanasi (25° 18' N, 83° 03' E) in Uttar Pradesh for seven years (meteorological and agrometeorological data) during the rabi season between 1989-90 to 1996-97 were analysed to study water requirement, water use efficiency, irrigation scheduling and crop coefficient during various growth stages of wheat. The soil at the experimental farm is clay-loam, medium deep with field capacity (FC) of 20.8 %, permanent wilting

TABLE 1
Crop yield and distribution of agroclimatic factor

Year	Duration in weeks	Frequency of irrigation	Rainfall (mm)	Departure from normal rainfall (mm)	AET (mm)	Yield (kg/ha)	W.U.E (kg/ha-mm)
1989 - 90	19	5	89.4	39.4	348	2900	8.3
1990 - 91	20	5	47.6	-2.4	362	3360	9.3
1992 - 93	16	4	31.4	-18.6	318	2168	6.8
1993 - 94	18	4	67.2	17.2	336	2560	7.6
1994 - 95	16	4	53.2	3.2	322	2450	7.6
1995 - 96	18	4	88.8	38.8	338	2955	8.7
1996 - 97	20	5	27.0	-23.0	356	3050	8.6
Average	-	-	57.8	-	340	2778	8.1

point (PWP) of 5.5 % and bulk density of 1.5 g/cc. The crop was sown during second fortnight in December and harvested in April. The growth duration of the crop varied between 16 to 20 weeks. The actual evapotranspiration (AET) was measured with gravimetric Lysimeter (1.3 × 1.3 × 0.9 m) fixed within the crop field, whereas data on meteorological parameters (maximum and minimum temperature, relative humidity, sunshine hours and wind speed etc.) recorded at the observatory located near the experimental farm, was obtained from India Meteorological Department, Pune. The weekly potential evapo-transpiration (PET) was calculated using Penmann's modified formulae (Doorenboss and Pruitt, 1977). The crop coefficient (K_c) was calculated by using the following relationship;

$$K_c = \frac{ET}{PET} \quad (1)$$

The irrigation interval (I) in days, has been calculated using the relationship ;

$$I = \frac{S_a \times p \times d}{ET} \quad (2)$$

Where, S_a = available soil water (mm/m), p = fraction of available water, d = effective root zone depth for irrigation, ET = peak value of evapotranspiration (mm/day). In the study, $p = 0.50$ has been assumed and the effective root zone depth for irrigation, $d = 90$ cm has been used (Michael, 1990).

2. *Consumptive use of water (AET), water use efficiency (WUE) and crop coefficient (K_c)* - The AET varied between 318 mm to 362 mm (Table 1). On an

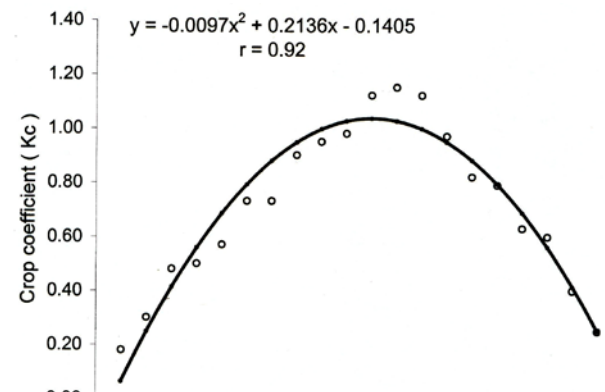


Fig. 1. Variation in crop coefficient (K_c) with time during the growth of wheat (1989-90 to 1996-97)

average the crop needs about 340 mm of water during the growth cycle. Since, Varanasi receives only about 50 mm of normal rainfall during the season (IMD 1999), rest of the water must come from supplementary irrigation. The crop yield varied from a low yield value of 2168 kg/ha during 1992-93 to high yield of 3360 kg/ha during 1990-91. The average yield of the crop was 2778 kg/ha. The lowest value of 6.8 kg/ha-mm was observed in 1992-93, while highest value of 9.3 kg/ha-mm was observed in the year 1996-97 (Table 1). It clearly indicates that water use efficiency does not depend only on the total amount of water consumed by the crop but also on its distribution during the various growth stages of the crop.

As wheat crop is sensitive to water stress, it should be irrigated regularly by maintaining high moisture level in the root zone, above 50% of the available soil water

with proper scheduling of irrigation in order to achieve good growth, development and yield. For this purpose, the irrigation interval (I) was calculated using equation (2). It was found that wheat crop needs to be irrigated regularly at an interval not exceeding 21 days. Any further delay in irrigation may adversely affect the growth, development and yield of the crop.

Fig. 1. shows variation in crop coefficient (K_c) with time, in weeks after sowing (WAS), during the growth of wheat. The values of crop coefficient (K_c) for wheat during different growth stages were compared with those given by Doorenbos and Kasam (1979) and agreed fairly well. When K_c values were fitted to time, in weeks after sowing (WAS), the following non-linear relationship ($r = 0.92$) was obtained,

$$K_c = -0.1405 + 0.2136 \times (\text{WAS}) - 0.0097 \times (\text{WAS})^2$$

Using this equation, it is possible to estimate K_c values, any time in WAS, during different stages of crop growth.

3. (i) The AET in wheat crop was found to have varied between the range 318 mm to 362 mm. On an average, wheat crop consumed about 340 mm of water during the growth cycle.

(ii) Water use efficiency does not depend only on the total amount of water consumed by the crop.

(iii) It is suggested from these studies, in order that wheat crop does not suffer from water stress, the crop needs to be irrigated adequately, at an interval not exceeding 21 days.

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