551.573.3 : 633.11

CROP COEFFICIENT FOR WHEAT CROP AT SELECTED LOCATIONS IN INDIA

1. Wheat is a staple food of a large population in India. It is extensively grown during the rabi crop season in winter. Due to low water holding capacity of the soils, the water need of wheat is most often seldom met and the farmer has to take recourse to supplementary irrigation whenever available or depend on dew falls (Chowdhury *et al.* 1990). Providing much needed water in adequate quantity to the crop during its critical phase cannot only save and improve its prospects but could also conserve water. This calls for a prior knowledge of exact water requirement of the crop.

Apart from the genetic characteristics, the water requirements depend on stage of growth cycle. The climatic factor which also govern the water requirement to substantial degree is the evaporative power of the atmosphere which is expressed as potential evapotranspiration (PET) and can be computed from conventional meteorological observations. Multiplication of PET by the crop coefficient (K_c) provide an estimate of crop evapotranspiration. The crop coefficient is a function of PET. Da Mota (1978) found K_c values for soyabeans, maize and groundnut. Olderman and Frere (1982) also reported K_c values for a few crops in different countries. Battawar *et al.* (1983) computed K_c values for each 5 or 10 per cent growth season for Sonalika wheat at Jabalpur for 3-year period.

An attempt has been made to determine the K_c values for some selected wheat growing areas of India.

2. *Material and methods*—Wheat was raised from 1980-81 to 1984-85 with some breaks at evapotranspiration observatories of Agrimet Division, Pune at New Delhi, Hisar, Jabalpur and Jorhat. ET measured by lysimeters at these stations, has been used. PET was calculated by modified Penman's method. This method is generally used when long term historical data of climatic parameters are available. The crop coefficient (K_c) have been estimated from the relation :

$$K_c = \frac{ET}{PET}$$

3. *Results and discussion — New Delhi* belongs to semi-arid climatic type (Rao *et al.* 1972). It receives about 60 cm rainfall during monsoon and about 5 cm in winter. The winter rainfall though small in quantity, is highly beneficial to the rabi crops. Temperature during rabi season are low, the lowest minimum is of 3°C during January. The K_c curves [Fig. 1(a)] shows inter and intra-seasonal variations conspicuously. These probably stem from different varieties used in different crop seasons.

A peak around 10-12 Weeks After Sowing (WAS) generally coincide with flowering when the water consumption is maximum is easily seen. A secondary peak, though minor, is seen in some of the years during milk formation stage. This is, however, marked in mean curve. A noteworthy feature is high value of K_c, nearly 2.0, around flowering, Battawar *et al.* (1983) also obtained K_c values as high as 1.65 for wheat at Jabalpur. Effect of plant senescence is clearly seen by a gradual decline in the K_c values after maturity.

Hisar—Hisar is located on the northeast fringe of Thar desert and has an arid climate. It receives 35 cm of rainfall in monsoon and receives 3 cm of beneficial rains during winter. Thermal characteristics resemble Delhi in practically all respects.

In Hisar also no unambiguous pattern [Fig. 1(b)] in K_c is seen, perhaps, a result of large number of varieties used. Irrigation provided to the crop at different phase could also have affected K_c. In some of the years a peak coinciding with flowering stage and a secondary peak 3-4 weeks later, is seen. Between 11-17th WAS the K_c is rather uniformly high ($\simeq$1.5).

Jabalpur — Jabalpur in moist sub-humid climatic regime receives fairly large rainfall (about 128 cm) during monsoon. It also receives less rainfall during rabi crop season (*i.e.*, 4 cm). Rabi crops are raised on residual moisture from monsoon or by supplementary irrigation. Temperatures though low are higher than in the north.

TABLE 1

Mean K_c values

Station	Phase					
	Germination	Tilering	Earhead emergence	Flowering	Grain formation	Maturity
New Delhi	0.4	1.1	1.6	1.9	1.7	1.3
Hisar	0.5	1.2	1.5	1.5	1.4	1.2
Jabalpur	0.4	0.9	1.0	1.3	0.9	0.5
Jorhat	0.5	1.0	1.4	1.3	1.1	0.7

From whatever data were available, a mean pattern could be drawn [Fig. 1 (c)]. It appears, three peaks is a characteristic feature at and around this location. A prominent peak is around 11th week after sowing with a K_c=1.70, coinciding with the period of reproduction. This is flanked on either side by two minor peaks, one about four weeks preceding it (with K_c=1.50) and the other, two weeks later. The second peak is not as large as the first one and has a crop coefficient of 1.25 Effect of fall in water demands after reproduction stage is clearly seen. The K_c values determined in the study, surprisingly agreed well with those given by Battawar *et al.* (1983).

Jorhat — Among the locations chosen in the study, Jorhat is not in the traditionally wheat producing area of the country. It has the most congenial moisture availability picture. Rain falls practically every month of the year. During rabi crop season minimum temperature ranges from 10° to 16 °C. In individual years Fig. 1 (d), the peak is seen at any time between earhead emergence and grain formation. Values of K_c remain about 1.5 between earhead emergence and end of grain formation. When data of all years is combined, no prominent peak is seen.

From above, it is obvious that irrespective of locations:

(*i*) Maximum demand for water by wheat is around flowering,

(*ii*) During late grain formation and early maturity, the demand though less, is nevertheless substantial, and

(*iii*) At its peak, the water need could be nearly as large as twice the evaporative demand.

The mean K_c values for wheat for each station is given in Table 1. The K_c gradually increases from germination as the plant development process takes place. It is observed that the highest K_c values are attained during flowering in all the stations. There is a drastic fall in the values from grain formation stage onwards at Jabalpur, however, fall in New Delhi and Hisar is uniform.

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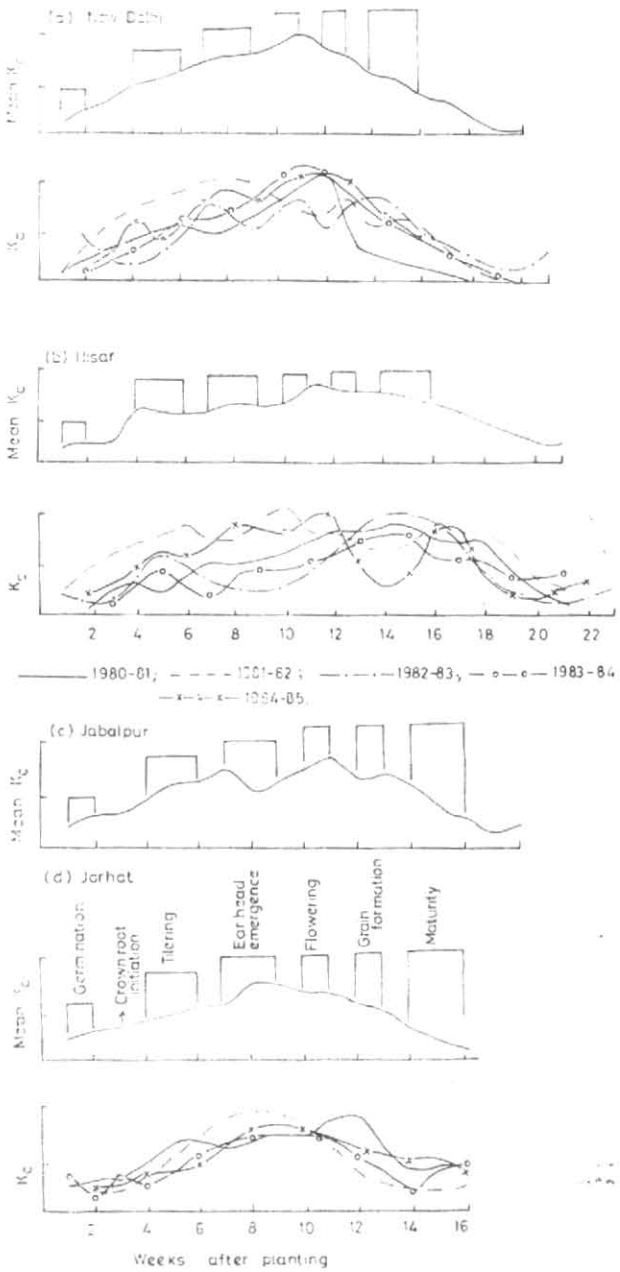

Figs. 1 (a-d). Distribution of K_c after planting at : (a) New Delhi (b) Hisar, (c) Jabalpua, and (d) Jorhat [Read—x—x—as 1983-84 and—o—o-as 1984-85]

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