ESTIMATION OF CONSUMPTIVE-USE (ET) FOR WHEAT CROP BY LYSIMETER TECHNIQUE

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Consumptive-use (ET) study on wheat crop was undertaken with the help of lysimeter installed at the experimental farm of the Directorate of Crop Production and Water Management, University of Agriculture, Faisalabad during rabi season of 1992-93. The irrigations were scheduled at the tillering, head development, flowering and grain formation stages of the wheat crop. The depth of irrigation varied as per requirement to meet the field capacity of soil. It was indicated that total consumptive-use (ET) of wheat crop was 329.07 mm during 160 days. The pan-evaporation during the same period was 431.23 mm. The daily water requirement of wheat crop was 2.06 mm/day. The study also indicated that consumptive-use (ET) increased during head development to flowering stage of crop indicating thereby high water demand. The grain yield was 5850.38 kg/ha and WUE obtained was 17.76 kg/ha.mm.

INTRODUCTION

Wheat is the most important rabi crop of Pakistan grown on more than seven million hectares, the largest area devoted to any single crop in the country. It is grown on 43% of the total cropped area of the country and accounts for 33% of the value added to the agriculture sector. Over the past 25 years, the area devoted to wheat cultivation in Pakistan has increased at a rate of 1.93% per year (5.3 mha in 1966-67 to 7.87 mha in 1991-92) (Anonymous, 1992). Despite the growing use of improved crop production technology, there has been almost no increase in wheat yield over the past few years (1.88 t/ha in 1985-86 and 1.99 t/ha in 1991-92) (Anonymous, 1992). This is partly due to lack of information regarding proper time and frequency of supplemental irrigation which often leads to grain yield far below the potential levels.

Irrigation is the most important factor which affects productivity of the crop upto a great extent. It is a fact that various crop development stages possess varying sensitivity to moisture stress (Doorenbos and Kassam, 1979). Many research workers reported that application of three to five irrigations at critical growth stages increased the yield of wheat to a greater extent (Arnon, 1972; Singh and Singh, 1979). It was, therefore, necessary to know the water requirement of wheat crop at various stages of crop growth which could be well estimated by lysimeter (Aboukhaled *et al.*, 1982).

MATERIALS AND METHODS

The study was conducted at the experimental farm of the DCPWM, University of Agriculture, Faisalabad on wheat variety LU26S grown during rabi season of 1992-93. The non-weighing type lysimeter having the size of 1.20 x 1.20 x 1.0 m^3 with outlet provided at the bottom for effective drainage of excess water was installed in the field. The soil, weighing approximately 2 tonnes, was filled in the lysimeter layerwise as that of field so as to simulate the field conditions. It was brought to

insitu conditions by following alternate wetting and drying cycles for a few days. Wheat was grown both in lysimeter and adjoining fields. The recommended package practices such as spacing, fertilizer, inter-culturing, plant protection measures, etc. were followed. The crop was supplemented with irrigation scheduled at the tillering, head development, flowering and at the grain formation stages of the crop. The soil moisture deficit was measured by gravimetric method. The drainage was collected from the bottom outlet of the lysimeter. USWB class A open evaporation pan was installed in the adjacent field so as to record the pan-evaporation.

RESULTS AND DISCUSSION

The results of grain yield, consumptive-use of wheat alongwith related climatological parameters are reported in Table 1. The data revealed that consumptive-use (ET) of wheat as observed from the lysimeter was 329.07 mm for a period of 160 days during the rabi season. Pan-evaporation during the period was observed 431.23 mm. An average ET/EP ratio during the crop growth period was 0.76. Four irrigations were applied to wheat during tillering, head development, flowering and grain formation growth stages of the crop. The depth of water applied was 240.80 mm. The rainfall received during growth period was 61.45 mm and total cumulative drainage was 32.44 mm. The grain yield of wheat obtained was 5850.38 kg/ha with water use efficiency of 17.76 kg/ha mm.

The data on evapotranspiration (ET), pan-evaporation (EP) and ET/EP ratio of different growth stages of wheat crop are given in Table 2. The study revealed that evapotranspiration rate (ET) was minimum during the establishment period and increased with the advancement in age of the crop. It was maximum during head development and decreased subsequently. Similar trend in ET/EP ratio was also observed. The ET/EP ratio was found to be minimum (0.43) upto the establishment period and increased there after. It was more than unity during head development stage followed by flowering stage (1.08). At maturity the ET/EP ratio was minimum (0.29).

Table 1. Grain yield and consumptive-use of wheat alongwith related climatic parameters

Particulars	Values
Total evapotranspiration (mm)	329.07
Total pan-evaporation (mm)	431.23
Duration of the crop (days)	160.00
Average ET (mm/day)	2.06
Average EP (mm/day)	2.70
ET/EP ratio	0.76
Total number of irrigations applied	4.00
Total depth of irrigation (mm)	240.80
Rainfall (mm)	61.45
Total drainage (mm)	32.44
Grain yield (kg/ha)	5850.38
Water use efficiency (kg/ha.mm)	17.76

Evapotranspiration (ET), panevaporation (EP), and ET/EP during rabi season is depicted

Table 2. Evapotranspiration (ET), pan-evaporation (EP) and ET/EP ratios at different growth stages of wheat crop

Stages	Days	(ET) (mm)	(EP) (mm)	ET/EP ratio
Establishment	15	15.57	42.63	0.36
Tillering	25	41.89	51.25	0.81
Head developme	50	111.49	95.25	1.17
Flowering	20	65.79	60.74	1.08
Grain formation	35	72.76	107.99	0.67
Ripening	15	21.57	73.40	0.29
Total:	160	329.07	431.26	0.76

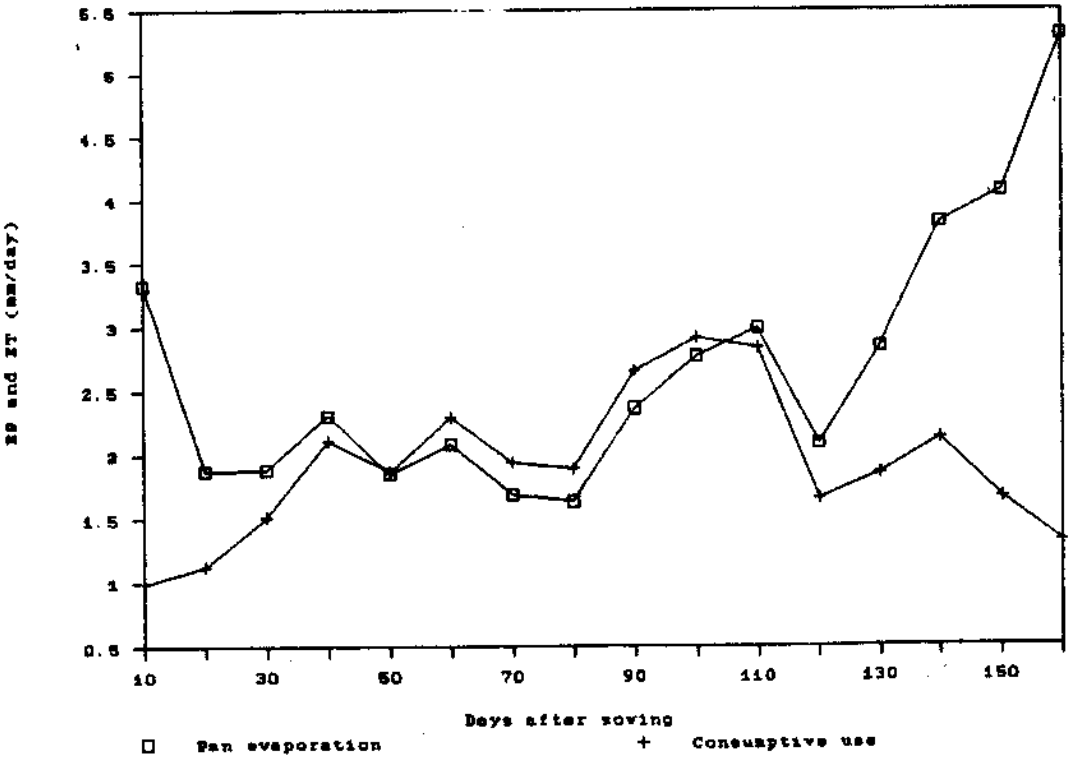

Figure. 1. Evapotranspiration (ET), Pan-evaporation (EP) of wheat crop during rabi season.

in Figure 1. The study revealed that ET values of wheat crop was minimum during first 20 days. The first irrigation applied during tillering stage. There after consumptive use was found to be increased. After 100 days crop turned into xerophytic stage and evapotranspiration values suddenly declined. The ET/EP ratio also decreased at later period of growth (Table 2). Pan-evaporation was found to be increased at the later part of growth period.

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