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CONSUMPTIVE USE OF WATER IN FINGER MILLET AND ITS RELATIONSHIP WITH EVAPORATION FROM DIFFERENT EVAPORIMETERS*

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Studies on irrigation of ragi indicated that simple and inexpensive 'can evaporimeter' can be recommended for scheduling irrigation to finger millet. There was significant positive correlation between evapotranspiration of the crop and evaporation from can evaporimeter, USWB Class A pan and sunken screen pan. The evaporimeters also had similar association. Irrigation at 2 cm CCE throughout the crop period provided optimum moisture for obtaining highest yield of (4,475 kg/ha) of finger millet.

Scheduling irrigation on the basis of soil moisture depletion is simple and inexpensive to be adopted by the farmers. Earlier studies have shown that there was high positive correlation between consumptive use of water by wheat and evaporation from screened evaporimeters (Sharma and Dastane, 1966). Evapotranspiration from a crop is closely associated with evporation from open pan (Pruitt and Lourence, 1968). Most of the evaportion pans are expensive and difficult to be handled by the farmers. Hence, investigations were carried out to test the usefulness of simple and inexpensive can evaproimeter for scheduling irrigation and to correlate between evapotranspiration of the crop and evaperiation from can evaporimeter, sunken screen pan and USWB Class A pan.

MATERIALS AND METHODS

A field experiment was conducted at the Tirupati campus of the Andhra Pradesh Agricultural University during summer (January to April) 1979 and 1980 in a randomized block design with six irrigation scheduling treatments. Two treatments (I_1 and I_2) were based on depletion of available soil moisture (25 and 50 percent DASM) and four were based on cumulative can evaporation (Bhaskara Reddy *et. al.*, 1980) (I_3 - Irrigation at 2 cm CCE for the first 25 days and 3 cm CCE for the remaining crop period; I_4 - Irrigation at 2 cm CCE for all through the crop period; I_5 -Irrigation at 3 cm CCE all through the crop period and I_6 - Irrigation at 4 cm CCE for the first 25 days and 6cm CCE for the remaining crop period). The treatments were replicated four times.

The soils are sandy loam, moderately alkaline (pH 8.0), low in total nitrogen, high in available phosphorus and low in available potassium. Soil moisture content at field capacity and permanent wilting point at different soil layers (Table 1) from 0-60 cm depth revealed that the soil had low moisture retentive capacity. The test

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variety was "Kalyani" finger millet of 105 days duration. Twenty five days old seedlings were transplanted with a recommended spacing of 15 X 12cm using one seedling per hill. A fertiliser dose of 90, 20 and 27 kg NPK/ha was applied. Nitrogen was applied in three equal splits, at planting, panicle initiation and flowering. Entire quantity of P and K was applied as basal.

The daily rate of evaporation was measured simultaneously from can evaporimeters kept in various irrigation treatments from USWB Class A pan and from sunken screen pan installed by the side of the field. The can was 10.3 cm in diameter and 14.3 cm in height and painted with white aluminium paint both inside and outside of the can. It had a cover of 0.8 cm mesh and a pointer fixed (inside the can at 1.5 cm below the rim) at the top upto which water was filled every day between 8.00 and 9.00 a.m. The cans were kept in the crop with the rim of the can at the same level as the height of the crop (Sharma and Dastane, 1970). With increase in crop height, the can evaporimeter level was also increased. The plots were irrigated at 25 and 50 percent depletion of available soil moisture. ET during the crop period was calculated by estimating soil moisture before and after each irrigation (Dastane, 1967). Correlations and regressions were worked out for ET and evaporation from different evaporimeters. Correlation coefficients were also calculated between evaporation values of the three different evaporimeters.

RESULTS AND DISCUSSION

Grain yield was maximum when irrigations were scheduled at 2 cm CCE (I_4) all through the crop period (high frequency irrigation) compared to all other treatments (Table 2). Grain yield was high when irrigations were scheduled at 25 percent DASM (I_1)compared to irrigation at 50 percent DASM(I_2). Low frequency irrigation (I_3 and I_6) resulted in lower grain yield. Maximum grain yield (4,475kg/ha) with I_4 may be due to optimum available soil moisture throughout the crop period. Availability of nutrients might have been more at higher level of available soil moisture (Sankara Reddi, 1978). The amount of water applied at each irrigation in I_6 was higher than the amount actually needed to wet the root zone depths and this might have led to deep percolation of water resulting in leaching losses of nutrients, especially nitrogen, thereby reducing its availability to the crop and lowering yields.

Data on correlation coefficients between ET and evaporation from can evaporimeter, sunken screen pan and open pan (Table 3) indicated that ET was highly correlated with evaporation from sunken screen pan (r = 0.9391) closely followed by can evaporimeter (r=0.9177) and open pan (r=0.9069 in 1979, whereas in 1980 the order was first can evaporimeter (r=0.8371) followed by open pen (r = 0.8030) and sunken screen pan (r = 0.7658). Further, evaporation from can evaporimeter was consecutively highly associated with that of open pan(r=0.9816 and 0.9071 in 1979 and 1980 respectively) and sunken screen pan (r = 0.8690 and 0.8435 in 1979 and 1980 respectively) during both the years. A positive significant association was also observed between evaration from open pan and sunken screen. As such all the three evaporimeters can be used for assessing evapotranspiration of finger millet. can evaporimeter being simple and inexpensive can be recommended to farmers for scheduling irrigation to finger millet.

Regression coefficients were also worked out between ET (from I₄ where the grain yield was maximum) and evaporation from three different evaporimeters in order to fit a linear regression equation for predicting the rate of change in one variable with the other (Table 3. Fig. 1 and 2). By using the regression equation, the predicted values of ET and evaporation from can, open pan and sunken screen have been represented graphically in a straight line (Fig. 1 and 2). The Predicted values are aiso to the regression line in can evaporimeter compared to the other evaporimeters indicating the accuracy and the usefulness of can evaporimeter in assessing evapotranspiration of finger millet or in predicting ET of finger millet.

Similarly, regression equations were also worked out between evaporation values of three different evaporimeters and have been presented graphically (Fig. 1 and 2). The predicted values are nearer to the regression line with evaporation values of can and open pan evaporimeters.

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Table 1. Soil moisture contents

	Depth of soil (cm)			
	0-15	15-30	30-45	45-60
Field capacity (%)	11.5 11.4	11.1 10.0	11.0 9.5	10.6 8.6
Permanent wilting point (%)	3.2 2.5	3.6 2.4	3.7 2.6	3.8 2.7
Bulk density (g/cc)	1.4 1.5	1.5 1.6	1.5 1.7	1.6 1.7

Table 2. Effect of irrigations on grain yields (kg/ha) of finger millet

Treat-	Number of irrigations		Total quantity of water applied		Grain yield	
ments	1979	1980	1979	1980	1979	1980
I_1	23	21	368	357	4081	4332
I_2	12	11	384	374	3699	3708
I_3	18	17	480	450	4006	4318
I_4	23	22	460	440	4466	4484
I_5	16	15	480	450	4111	4183
I_6	9	9	480.	480	3551	3628
CD 5%					269	426
CV %					4.48	6.88

Table 3. Correlation and regression coefficients for evaporation from different evaporimeters at I_1.

Correlations	1979 Calculated 'r' value	1979 Regression equation	1980 Calculated 'r' value	1980 Regression equation
Can evaporimeter Vs consumptive use	0.9177**	Y = 0.1428 + 0.6394 X	0.8371**	Y = —1.3642 + 0.7154 X
Open pan evaporimeter Vs consumptive use	0.9069**	Y = 3.6567 + 0.4358 X	0.8030**	Y = 3.0590 + 0.4619 X
Sunken screen pan evaporimeter Vs consumptive use	0.9391**	Y = 2.4733 + 0.7785 X	0.7658**	Y = 2.7384 + 0.6144 X
Can evaporimeter Vs evaporation from open pan evaporimeter	0.9816**	Y = 5.6094 + 0.6771 X	0.9071**	Y = 6.7426 + 0.6255 X
Can evaporimeter Vs evaporation from sunken screen pan evaporimeter	0.8690**	Y = —0.9357+0.7303X	0.8435**	Y = —0.1696 + 0.8755 X
Open pan evaporimeter Vs evaporation from sunken screen pan evaporimeter	0.8846**	Y = 2.7011+0.5126X	0.8925**	Y = 3.0130 + 0.6555 X

**Highly significant at 1 percent level