https://doi.org/10.29321/MAJ.10.A02430

*Madras Agric J* 71 (1) 21-24 January 1984

# EVALUATION OF WATER REQUIREMENT OF RICE USING SOLI & WEATHER PARAMETERS*

R. K. SAHU AND B. ANJANEYULU**

An attempt was made at Salkuti (W.B.) to evaluate the water requirement of rice grown in winter (boro) season. It was found that during the boro season the water requirement of rice was 749.20 mm, of which 611.40 mm was evapotranspiration and rest 137.80 mm was percolation. It was found that the crop coefficient was linearly related to the days after transplanting. It was also found that the deep percolation can be predicted to a reasonably good accuracy using the depth of saturated water front below ground level as suggesred by Danial Dicker (1969).

The total water requirement of rice consists of mainly evapotranspiration on percolation' The evapotranspiration can be estimated either by empirical formula using several meteorological factors or from the known evaporation rate by using a suitable crop coefficient. The percolation can be measured either by single cylinder infiltrometer, deeply inserted in the soil or by using the physical properties of soil. A theoretical method for estimating the depth of water required for successful growth of rice crop is presented in this paper.

The boro rice demands large quantity of water due to excessive evaporation rate. Due to abundance of solar energy' high yielding variety planted during the winter gives better yield than those planted in rainy season. Water table starts falling rapidly once the rainy season is over, therefore, water requirement of rice should be evaluated in advance to have realistics planning of water resources to put maximum area under cultivation.

## MATERIAL AND METHODS :

Evapotranspiration and percolation in rice fields were measured by 'Drum Culture Technique' as suggested by Dastane (1967). Rainfall and evaporation were measured with the help of a non recording type of raingauge and U. S. W. B. class A pan evaporimeter respectively, installed near the Drum Culture Experiment. The Saket-4, a high yielding rico variety was planted in the drums. The crop coefficient values were worked out as proposed by Hargreaves (1968) and presented in Table 1 The crop coefficient values were then correlated with the days after

** Paper presented in the 18th annual convention of I. S. A. E. at Karnal

** Asstt. Agril. Engineer. Khar Land Research Station, Panvel and Professor, Agril. Engg. Deptt. I. I. T. Kharagpur (W B,) respectively.

transplanting (Table 2).The percolation loss in rice fields was predicted using the physical properties of soil as suggested by Danial-Dicker (1969). Accordingly, Total depth of percolation of water = n l —(1)

where n is the drainable porosity of soil l is the depth of saturated water front below the ground level at time t from the start of irrigation l is calculated by the following formula by trial and error.

$$l = C \ln \frac{(l + C)}{C} + \frac{K.t}{n} \quad —(2)$$

where C is the constant depth of water at the soil surface. K is the saturated hydraulic conductivity of soil and t is the time.

The physical properties of soil such as bulk density, saturation percentage and field capacity were determined to find out the drainable porosity of soil (Table 3). The undisturbed soil samples were also tested for the saturated hydraulic conductivity. The constant depth of 5 0 cm of water was maintained throughout the growth period of 86 days.

## RESULTS AND DISCUSION

The crop coefficient varies with the stage of crop growth. Under certain agroclimatic conditions, the crop coefficient, is more or less constant for a particular growth stage. It was found that the linear relation ship exists between crop coefficient and days elapsed after transplanting. Upto the milky stage (55 days after transplanting) the crop coefficients increases linearly while afterwards it decreases linearly upto the harvesting stage. At the time of harvesting and at the time of planting the crop coefficient is nearly about 1.0. At milky stage (55 days after transplanting) the crop coefficient was found to be maximum i.e. 1.5. Linear regression equations were worked out, (Table 2) to predict crop coefficient at any particular stage

**Predicting Percolation Loss in Rice Fields :**

The saturated hydraulic conductivity of soil, K = 1.59 mm/day
Growth period t = 86 days
Constant depth of water maintained in rice fields, C = 50 mm
Drainable porosity of soil, n = 0.091

On putting these values in equation (2)

$$l = 50 \ln \frac{l + 50}{50} + \frac{1.59}{0.091} \times 86$$

On solving, l = 1680 mm
Therefore, total percolation
= n l
= 0.091 X 1680
= 152.86 mm

This predicted percolation value is reasonably close to the percolation observed from the drum culture technique, i e 137.78 mm.

These results suggest that the water requirement of rice in a particular region could be evaluated in advance, after developing the necessary regressions such as shown in Table 2 using weather parameters viz evaporation and with the help of equations (1) and (2) using the physical parameters of soil.

The authors are thankful to the Agril. Engg Deptt. and W. M. A. P. Scheme, Indian Institute of Technology, Kharagpur (W.B.) for providing physical facilities and to Ford Foundation for providing the financial support during the study period. This work forms a part of the M. Tech, thesis of the first author.

REFERENCES

DASTANE, N. G. (1967) A practical manual for water use research. Navbharat Prakashan Pune-4.

DICKER, DANIAL (1969). Transient free surface flow in porous media, Flow Through Porous Media. Academic Press, New York 294-298.

HARGREAVES, G. H.. (1968). Consumptive use derived from evaporation pan data, J. Irrig & Drainage Division, ASCE, 94 (IR-I)

SAHU, R. K. (1980). Studies on irrigation efficiency in shallow tubewell command area Unpublished M. Tech. thesis. Agril. Engg. Dept. I. I. T. Kharagpur. (W. B.)

Table 6 : Evaporation. Evapotranspiration and Evapotranspiration Combined with percolation data (mm) of rice fields.

Date of transplanting : 1/2/ 1980 Crop : Rice
Date of harvesting : 26/4/1980 Variety : Saket-4

| Period | Evapotranspiration | Evapotrans piration + percolation | Evaporation | Crop Coefficient |
|---|---|---|---|---|
| Feb. 1-5 | 11.86 | 17.77 | 11.48 | 1.03 |
| Feb. 6-10 | 14.25 | 21.61 | 13.26 | 1.07 |
| Feb. 11-15 | 13.78 | 20.42 | 12 29 | 1.12 |
| Feb. 16-20 | 15.80 | 23.90 | 13.69 | 1.15 |
| Fed. 21-25 | 22.11 | 31 62 | 17.71 | 1.26 |
| Feb 26-Mar 1 | 31.22 | 40.58 | 24.73 | 1 26 |
| Mar. 2-6 | 23.08 | 30.99 | 17.52 | 1.32 |
| Mar. 7-11 | 18 98 | 27.67 | 13.75 | 1.38 |
| Mar 12-16 | 34.34 | 42 49 | 24.38 | 1.41 |
| Mar. 17-21 | 42.44 | 50 58 | 29.24 | 1 45 |
| Mar. 22-26 | 47.64 | 57.37 | 31.99 | 1 49 |
| Mar. 27-31 | 42.10 | 51.87 | 28.61 | 1.47 |
| Apr. 1-5 | 38.39 | 46 19 | 27 88 | 1.38 |
| Apr. 6-10 | 56 53 | 65 61 | 45.16 | 1.30 |
| Apr. 11-15 | 55.16 | 61.69 | 44 68 | 1.23 |
| Apr. 16-20 | 66.12 | 74.02 | 57.39 | 1.15 |
| Apr. 21-26 | 75.71 | 84 92 | 77 55 | 0 98 |
| Total | 611 40 | 749.20 | 491.30 | |

Table 2 : Functional relationsoip between crop coefficient (Y) and days after transplanting (X) of boro rice*

| Growth stage | Days after transplanting | Correlation Coefficient | Linear regression Eequation |
|---|---|---|---|
| Transplanting to milky stage | 1-55 | 0.88 | 100Y=98.578 +0.938X |
| Milky stage to harvesting srage | 55-86 | 0.98 | 100Y=242 324−1 923X |

Table 3 : Determination of drainable porosity of soil in rice fields.

| Depth | Bulk density gm/cc | Field Capacity % | Saturation percentage | Drainable porosity% |
|---|---|---|---|---|
| 0-10 | 1.39 | 24.71 | 31.16 | 9 00 |
| 10-20 | 1.40 | 24 95 | 32.07 | 10.00 |
| 20-30 | 1.41 | 27.33 | 34.51 | 10.00 |
| 30-40 | 1 37 | 22.93 | 29 59 | 9.14 |
| 40-50 | 1.39 | 26 76 | 33.11 | 8 85 |
| 50-60 | 1 43 | 24.50 | 33.11 | 9 44 |
| 0-10 | 1.43 | 24 89 | 34.90 | 8.61 |
| 10-20 | 1.41 | 23 43 | 28.95 | 7.79 |
| 20-30 | 1.39 | 32.14 | 38 48 | 8.80 |
| 30-40 | 1.45 | 31.22 | 37 31 | 8 63 |
| 40-50 | 1.44 | 28.84 | 35.47 | 9 59 |
| 50-60 | 1 46 | 30.43 | 36.80 | 8.56 |
| 0-10 | 1.41 | 24 78 | 31.20 | 9 04 |
| 10-20 | 1.38 | 26.87 | 34.87 | 8.99 |
| 30-40 | 1.40 | 25.91 | 31.59 | 9 36 |
| 40-50 | 1.43 | 26.24 | 33.69 | 10 64 |
| 50-50 | 1 38 | 29 55 | 36 35 | 8 81 |

On an average drainable porosity of soil in rice fields upto 60 cm eepth=9.10 %.