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ABSTRACT

The study was carried out to estimate a reference crop evapotranspiration (ETr) and actual evapotranspiration for Udaipur Region (latitude 24°52"N and longitude 74°21"E) at 522 Mean sea level in the north-western* zone, Udaipur. .** ***Actual major crop evapotranspiration was determined by the crop coefficient (kc) approach where the effects of various weather conditions were incorporated into reference crop evapotranspiration and crop characteristics into crop coefficient. The average ETr values over the year (2012) by Penman-Monteith method were determined. The result was shown that the average annual values of water to be applied per crop for a season of green gram, maize and seasame crop for Udaipur district are: 471, 586.52 and 552.86 mm by penman method.

Keywords: *Reference Crop Evapotranspiration (ETr), Crop Coefficient (kc), Green Gram, Maize and Seasame Evapotranspiration (ET_C).*

1. INTRODUCTION

The evapotranspiration rate from a reference surface, not short of water is called the reference crop evapotranspiration (ETr). The reference surface is the hypothetical grass reference crop having close resemblance with an extensive green surface, well-watered grass of uniform height, actively growing and completely shading the ground Kakade (1985). Knowledge of evapotranspiration is essential for efficient management of water resource, crop production, and environment assessment. It further continues to be foremost important in water resource planning and management.

As stated earlier the estimation of evapotranspiration of green gram, maize, and sesame crop is necessary for appropriate irrigation water management. The crop evapotranspiration is related to reference crop evapotranspiration (ETr) through a factor called crop coefficient (kc). Hence the crop coefficient values for green gram, maize and seasame crops that were determined by Food and Agriculture Organization (Doorenbos and Pruitt, 1977) based on the average crop coefficient values all over the world are used by the researchers, planners and managers of water resources system across the world. However, FAO values are average over different agro-climatic regions and provide only guidelines. Therefore, for proper estimation of ET_c, it is necessary to develop k_c values locally.

The evapotranspiration is the important component of determination water requirement. Evapotranspiration is required for proper water management in the problems involving the estimation of water availability, water supply, and water demand/requirement. Evapotranspiration data are essential for planning of crop production. As explain above evapotranspiration is an important component in irrigation planning and therefore it is important to know its accurate estimate for crops and their growth stages.

2. MATERIALS AND METHODS

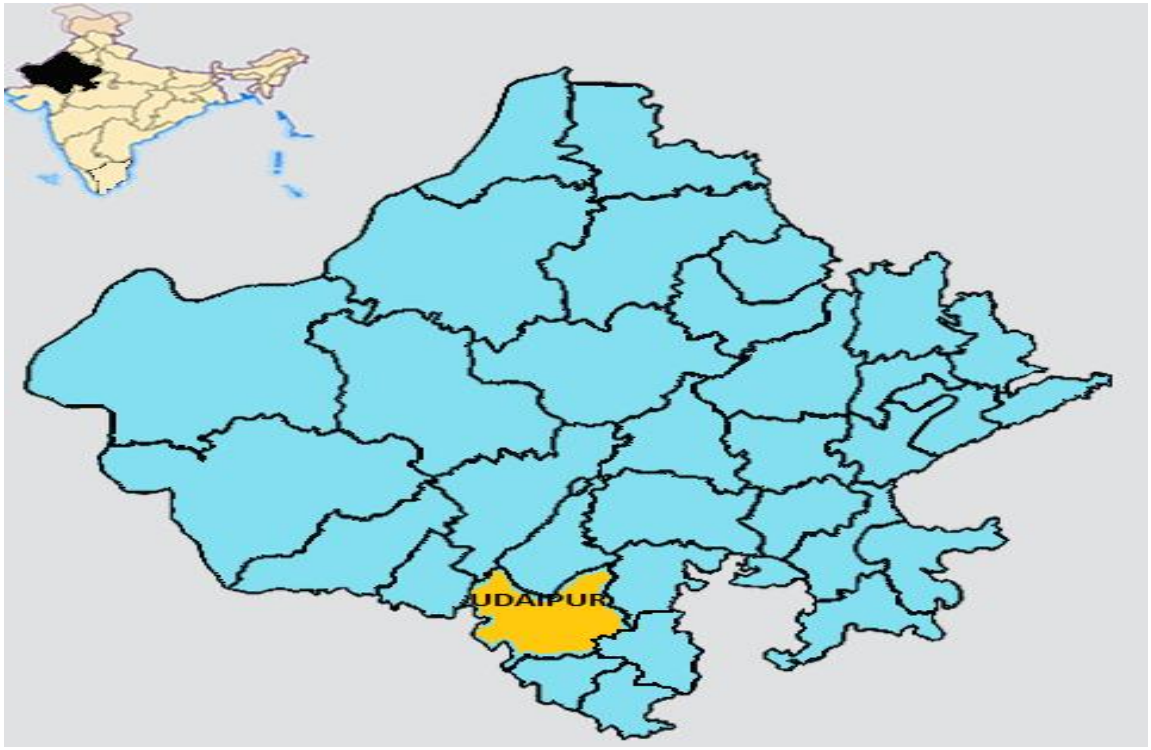
Collection of Historical Rainfall Data

In this study, the data collected from various authenticated sources.

- Meteorological data: Daily parameters (i.e. maximum temperature (T_{max}, ^{0}C) and minimum temperature (T_{min}, ^{0}C), maximum relative humidity (RH_{max}, %) and minimum relative humidity (RH_{min}, %), pan evaporation (E_{pan}, mm), wind speed (WS, kmhr^{-1}) at height of 2.0 m, sun shine hours (SSHr, hr), rainfall (R, mm)) etc. collected from Dharta metrological department
- Information regarding kc collected from Food and Agriculture Organization (Doorenbos and Pruitt, 1977).

Location of Study Area

- The study carried out for Udaipur district of Rajasthan having latitude 24°52"N and longitude 74°21"E) at 522 Mean sea level.



Estimation of Reference Crop Evapotranspiration (ETr)

The weekly reference crop evapotranspiration estimated by using the standard method i.e. Penman- Monteith (Allen *et al.*, 1998) for the present study and is given by,

$$ETr = \frac{0.408\,\Delta\,(R_n - G) + \gamma\left(\frac{900}{T+273}\right)u_2\,(e_s - e_a)}{\Delta + \gamma\,(1 + 0.34\,u_2)} \quad \ldots. (1)$$

Where,

ETr = reference crop evapotranspiration (mm/day),
G = soil heat flux density (MJ/m^2/day),
R = net radiation (MJ/m^2/day),
T = mean daily air temperature (^{0}C),
Γ = psychometric constant (kPa/^{0}C),
Δ = slope of saturation vapour pressure function (kPa/^{0}C),
e_s = saturation vapour pressure at air temperature T (kPa),
e_a = actual vapour pressure at dew point temperature (kPa),
u_2 = average daily wind speed at 2 m height (m/sec).

Crop Coefficient (Kc)

The phenological stage wise crop coefficient values used for different phenological stages i.e. new leaf initiation, crop development, flowering and crop harvesting (Doorenbos and Pruitt, 1977).

Evapotranspiration

The weekly values of ETr and Kc used to obtain weekly values of ET_C by the equation.

$$ET_C = ETr \text{ X } kc \quad \text{……. (2)}$$

Where,

ET_C = Evapotranspiration (mm/day),
ETr = Reference crop evapotranspiration (mm/day),
Kc = Crop coefficient

3. RESULTS AND DISCUSSION

The study has been undertaken with the broad objective of crop water requirement of major crops of Udaipur region Weekly reference crop evapotranspiration (ETr) values for the period (2012) were computed by the Penman-Monteith FAO-56.

Crop Coefficient of Seasame, Maize and Green Gram

These coefficients are dimensionless numbers that are multiplied by the ETr values to know crop evapotranspiration. It varies with crops, phenological stages of the growth of the crop, elevation the crop is being grown, by the time of the years and specific cultural or management practices. The crop coefficient generally varies from very small around 0.35, 0.3 and 0.4 for early season and very large around 1.0, 1.20 and 1.05 for mid seasons for seasame, maize and green gram (Johnson *et al.*, 2005). The kc values were determined by measuring the shaded area at solar noon of seasame, maize and green gram plant weekly for the plant of ages (110,110 and 100 days respectively). The resulting crop evapotranspiration (ET_C) would be of help to an irrigation manager to schedule when irrigation should occur and how much water should be put back into the soil.

Evapotranspiration of Seasame, Maize and Green Gram (ET_C)

In this study, ETr values were estimated by Penman-Monteith discussed in previous sections. This section deals with the estimation of evapotranspiration (ETc) for the crop. The values of seasame, maize and green gram evapotranspiration (ET_C) were estimated from reference crop evapotranspiration (ETr) and crop coefficient (kc) values. The Penman-Monteith method which is considered as the most accurate and proposed by FAO, Irrigation and Drainage Paper -56 (Allen *et al.*, 1998) for use was considered for the cotton evapotranspiration. These values are in depth unit (mm). However, the results are presented in mm/day/crop since most of the growers use drip irrigation system which has drippers calibrated in mm/hour and operates at a level of 90 % irrigation efficiency. The amount of water to be applied to the seasame, maize and green gram crop in mm/day/crop for Udaipur, were calculated and discussed below in this section.

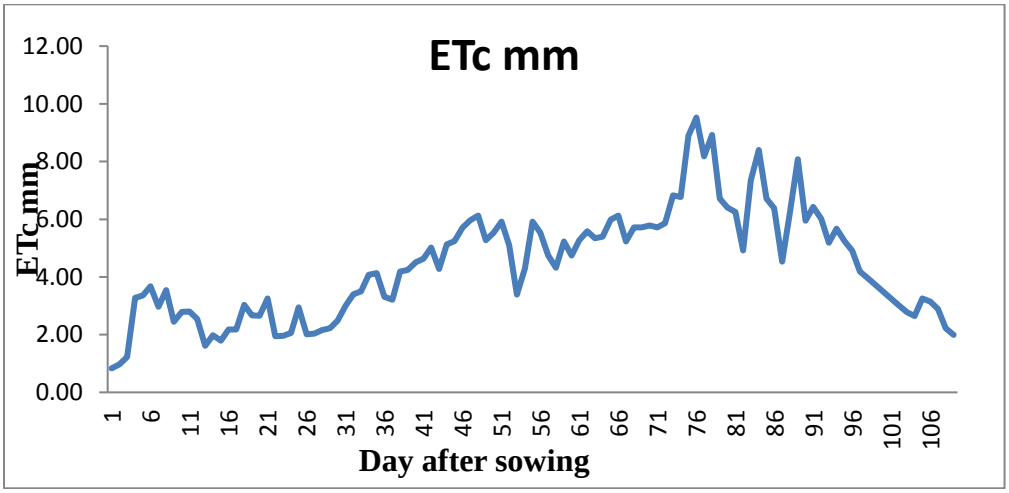


Fig.1. Variation of Evapotranspiration (ET) During Period of Seasame Crop Predicted by the Penman-Monteith (PM) Method

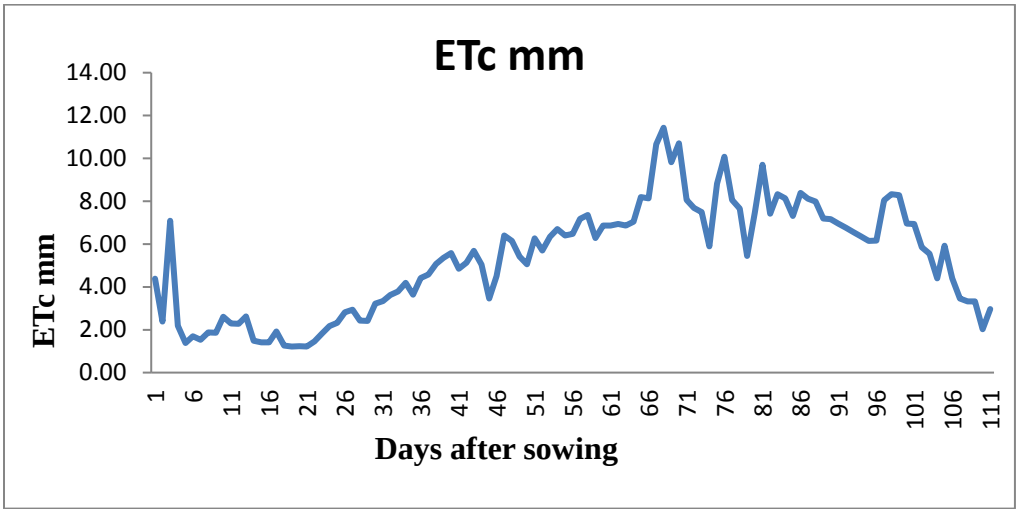


Fig.2. Variation of Evapotranspiration (ET) During Period of Maize Crop Predicted by the Penman-Monteith (PM) Method

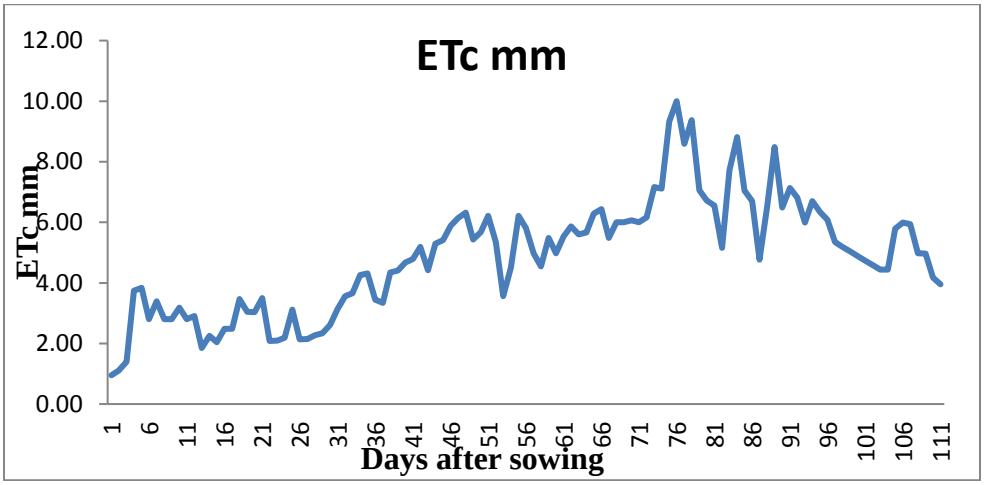


Fig.3. Variation of Evapotranspiration (Et) During Period of Seasame Crop Predicted by the Penman-Monteith (Pm) Method

Udaipur District

The initial values of water use are 2.2, 4.26, 3.25, and 5.55 mm/day/crop for seasame, maize and green gram crop. It gradually increases during different phenological development stages of seasame, maize and green gram crop (i.e. new leaf initiation, crop development, flowering, and harvesting and).The seasonal values of water to be applied to the green gram, maize, and seasame crop are 471, 586.52 and 552.86 mm/year for green gram, maize, and seasame crop. Evapotranspiration (ET_C) values vary from 3.03 to 6.30 mm/day/crop due to the variation of reference crop evapotranspiration, crop coefficient.

4. CONCLUSION

The ETr values over the year (2012) for Penman-Monteith method is 471, 586.52 and 552.86 mm.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] Allen, R. K., L. S. Pereira, D. Raes and M. Smith. 1998. Crop evapotranspiration. Guideline for computing croweater requirements. *FAO Irrigation and Drainage* Paper No. 56.United Nations Food and Agricultural Organization, Rome.

[2] Alves, J. Jr., M.V. Folegatti, L. R. Parsons, W. Bandaranayake, C. R. da. Silva, T. J.A.da Silva, and L.F.S.M. Camppeche. 2007. Determination of crop coefficient for grafted Tahiti lime trees and soil evaporation coefficient Of Rhodic Kandiudalf clay soil in Sao Paulo, Brazil. *Irrigation Science*. 25 (4):419-428.

[3] Blaney, H. F. and W. D. Criddle. 1962. Evaporation from free water surface at high altitudes. *Trans. of ASCE*. 123: 243-265.

[4] Bhakar, S.R. and R.V. Singh. 2003. Estimation of reference evapotranspiration under sub-humid climatic conditions Of Rajasthan. Proceedings 37th ISAE Convention, held during January 29-31, 2003 at CTAE, MPUAT, Udaipur. II: 89-92

[5] Doorenbos, J. and W. O. Pruitt. 1977. Guidelines for predicting Crop Water Requirement: *FAO Irrigation and Drainage* Paper No.24, FAO, Rome, Italy. pp.156.

[6] Hargreaves, G. H. 1975. Moisture availability and crop production. *Transaction of ASAE*. 18(5): 980-984.

[7] Kakade, J.R., 1985. Agricultural Climatology. Metropolitian Book Co. Pvt. Ltd., New Delhi: 165 -166.

[8] Penman, H.L.1948. Natural evaporation from open water, bare soil, and grass. Proc. Royal Soc. London, Sev.A.193: 20-145.

[9] Salam, M. A. and S. A. Mazrooe. 2006. Evapotranspiration estimates and water balance of Kuwait. *Journal of Agrometeorology*. 8: 243-247.

[10] Seung H. Y., Jin Y. C. and Min-Won J. 2008. Estimation of design water requirement using FAO56 PM and optimum Probability distribution function in South Korea. *Agricultural Water Management.* 95(7): 845-853.

[11] Singandhupe R.B. and Ranu Rani Sethi .2004. Computation of evapotranspiration by different methods-A case study. Indian J. Soil Cons. 32(1) 5-9.

