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IRRIGATION ENGINEERING

[BTAI 2201]

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Water Balance Method:

The water balance model of a crop field (generally non-paddy) under unsaturated phase is expressed (**B. Panigrahi, 2001**) as:

$$S_{w,i} = S_{w,i-1} + R_i + I_{s,i} - ET_{crop\ i} - SR_i - S_i - D_i$$

where, R = rainfall; I_s = supplemental irrigation, $ET_{crop\ i}$ = evapotranspiration of the crop; SR = runoff from the crop field; D = percolation loss in the crop field, S = seepage loss from the crop field and S_{wi} and S_{wi-1} = SMC on i th and $(i-1)$ th day, respectively. The term i of the above equation refer to the day which may be taken as 1 day.



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Water Balance in Paddy Field (B. Panigrahi, 2001)

$$D_{p,i} = D_{p,i-1} + R_i + I_{s,i} - ET_{crop_i} - SR_i - S_i - D_i$$

where, D_{pi} and D_{pi-1} are the ponding depths occurred at the end of day i and $i-1$, respectively.

Other terms of the equation are described as above.



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Estimation of Evapotranspiration:

$$ET_{crop} = K_s \cdot K_c \cdot ET_o$$

where, ET_{crop} = crop evapotranspiration or simply evapotranspiration; K_c = crop coefficient, K_s = Crop stress factor (1 for adequate SMC) and ET_o = reference crop evapotranspiration or potential evapotranspiration.

$$K_c = \text{FAO 24}$$

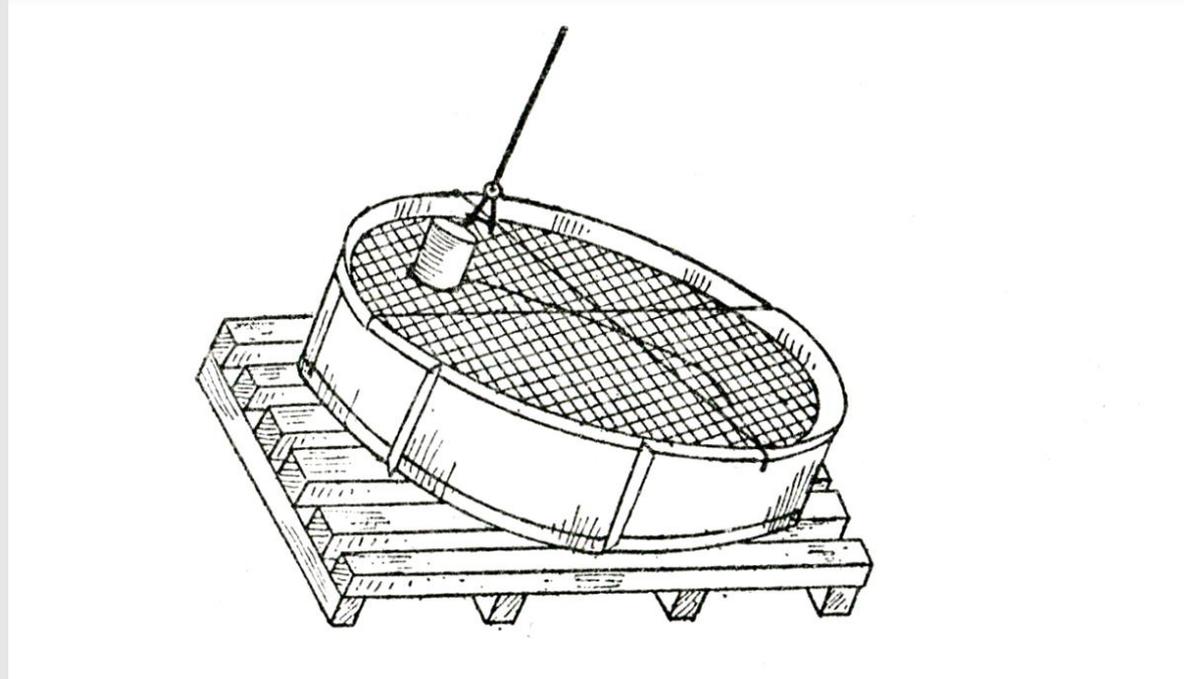
$$K_s = \text{FAO 56}$$



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Estimation of ETo by **Pan Evaporation Method**





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Estimation of E_{To} by Pan Evaporation Method

$$E_{To} = E_{pan} K_p$$

Where, E_{pan} = Pan Evaporation & K_p = Pan coefficient

Sample Calculation: Calculate the reference crop evapotranspiration value (E_{To}) as measured by class A open galvanized pan in a given site under the following conditions with data measured as:

Water level in the pan on previous day at 7 A.M. is 18.5 cm & that measured after 24 hours at the same time is 20.5 cm. There is 7.0 cm rainfall in between 24 hours. Assume $K_p = 0.75$



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Solution:

There is 7 cm rainfall within the two consecutive day's readings of water measurement.

Water level readings on previous day = 18.5 cm

Water level reading on day after 24 hours = 20.5 cm

Hence, the value of $E_{pan} = 18.5 + 7.0 - 20.5 = 5$ mm/day.

$$K_p = 0.75$$

Hence, $ET_o = E_{pan} K_p$

$$= 5 \times 0.75 = 3.85 \text{ mm/day.}$$



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Crop Coefficient (K_c) for Estimating Actual Evapotranspiration:

The values of K_c for a particular crop at a location should be determined experimentally. If the values of K_c for particular crop and place are not available then the K_c (FAO 24/FAO 56) may be used.

Values of KC during initial and maturity stage of crop are less and so ETo is less.

During Crop development and Mid season stage KC is high and so ETo is high.



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Trend of Kc values of crops

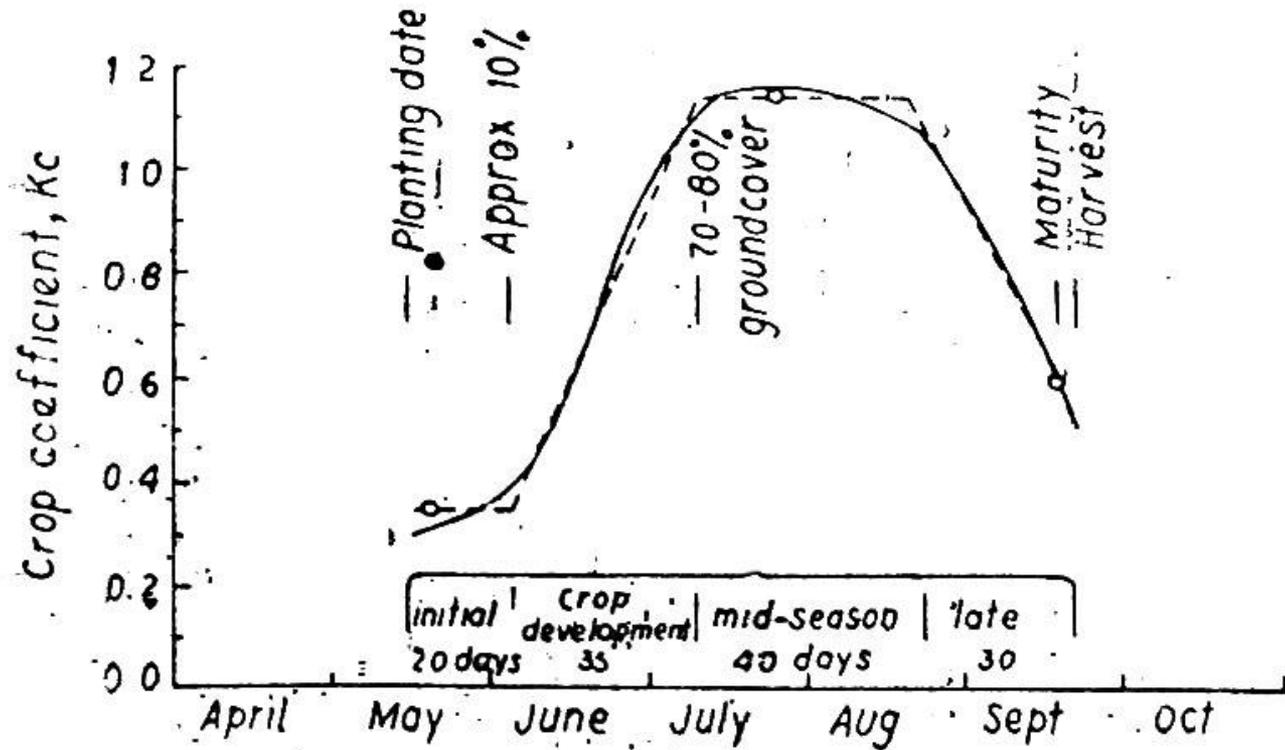


Fig. 9.4 Example of crop coefficient curve.



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THANK YOU