



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

IRRIGATION ENGINEERING

[BTAI 2201]

Prepared by:

Birabhadra Rout

Assistant Professor

Dept. of Agricultural Engineering
SoABE, CUTM, Paralakhemundi



Centurion
UNIVERSITY

Shaping Lives...

Empowering Communities...

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.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

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.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Estimation of Evapotranspiration:

$$ET_{crop} = K_s.K_c. ET_o$$

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 = FAO 24

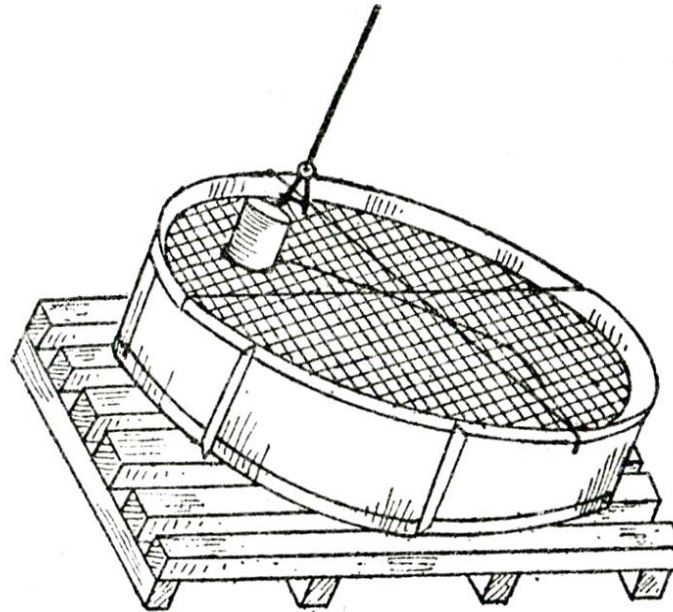
K_s = FAO 56



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Estimation of ETo by **Pan Evaporation Method**





Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

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 $K_p = 0.75$



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

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

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



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

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

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



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Trend of K_c values of crops

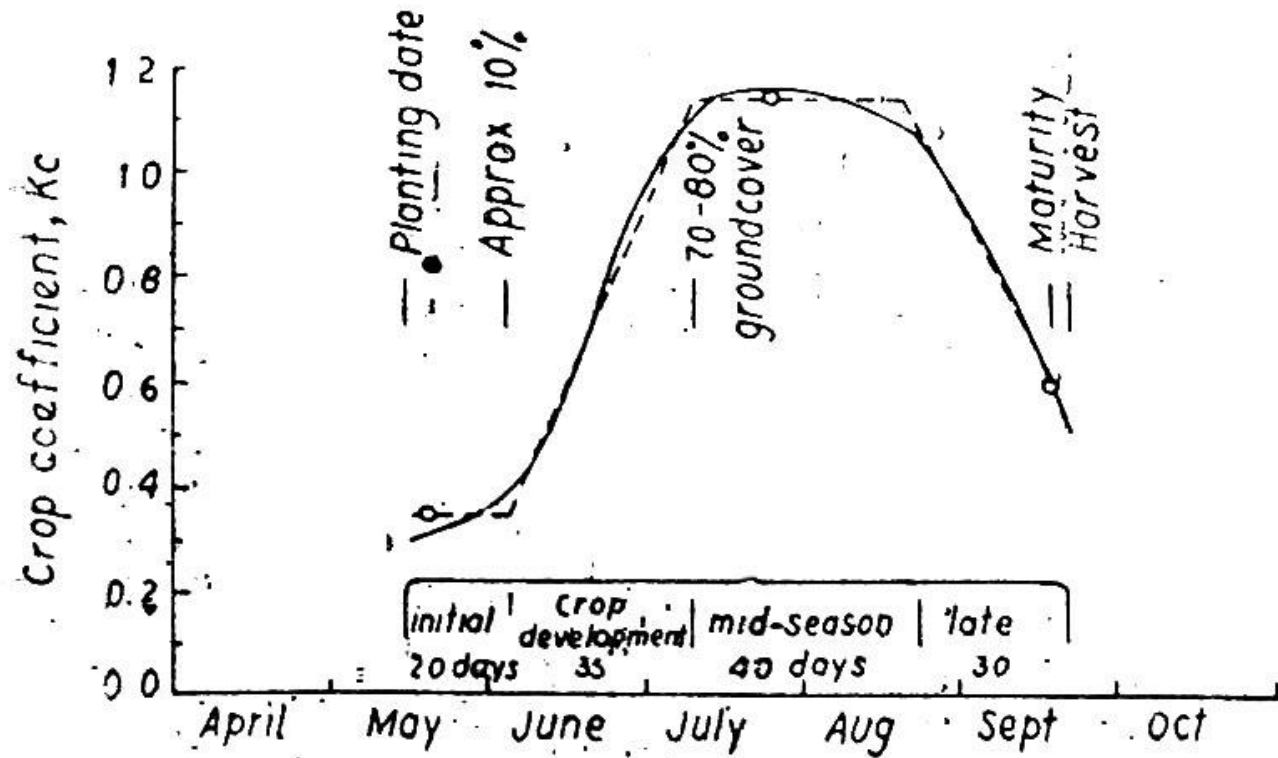


Fig. 9.4 Example of crop coefficient curve.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

THANK YOU