$$dw = \frac{1450}{1000} \times 1.8 \times (F.C. - 0.08) \quad \text{—(1}$$

Now, we need to find dw (available water)

- It can be find out by

$$\text{Depth } (dw) = \frac{\text{Volume } (V)}{\text{Area } (A)}$$

But, these losses are given so, we need to substract it from total volume of water

$$\text{Actual volume of water} = \text{Total Volume of water} - \text{Losses}$$

$$= 650 - \left(650 \times \frac{10}{100}\right)$$

$$= 650 - 65$$

$$V_{actual} = 585 \ m^3$$

So,

$$\text{Depth } (dw) = \frac{585}{1000} = 0.585 \ m = 585 \ mm$$

From eqn (1)

$$0.585 = 1.45 \times 1.8 \times (F.C - 0.08)$$

$$F.C - 0.08 = 0.585 / 1.45 \times 1.8 = 0.224$$

$$F.C = 0.224 + 0.08 = 0.304 = 30.4\ \%$$

Ex-2.23

Garg (64)

A certain crop is grown in area of 3000 ha., which is fed by a canal system. The data pertaining to irrigation are as follows;

Field Capacity = 26 %.
Optimum m.c. = 12 %.
Permanent wilting point = 10 %
Effective root zone depth = 80 cm = 0.8 m
Apparent relative density of soil = 1.4 gm/cc

If the frequency of irrigation is 10 days & the overall efficiency is 22 %, find;

i- the daily consumptive use
ii- the discharge in m^3/s required in the canal feeding the area.

Soln,

Given data;

F.C. = 26 % = 0.26
O.M. = 12 % = 0.12
PWP = 10 % = 0.10
d = 0.8 m
γ_d = 1.4 gm/cc , γ_w = 1.0 gm/cc (Assu
f = 10 days
$\eta_{overall}$ = 22 % = 0.22

- we know that

$$\text{Available water (dw)} = \frac{\gamma_d}{\gamma_w} \times d \times (F.C. - O.M.)$$

$$= \frac{1.4}{1} \times 0.8 \times (0.26 - 0.12)$$

$$= 156.8 \text{ mm}$$

i.) Daily Consumptive use (Cu)

$$= \frac{\text{Available water}}{\text{frequency}}$$

$$= \frac{156.8}{10}$$

$$= 15.68 \text{ mm/day}$$

ii.) Total discharge in m^3/s

- Here, we need to consider overall efficiency & losses

Daily application = 15.68 mm

Considering efficiency 22%.

Actual need of daily water = $\frac{15.68}{0.22} = 71.27$

Actual need of daily water = Area x depth in terms of volume

$$= 3000 \times 10^4 \times 0.0712$$ (m^2) (m

$$= 213.8 \times 10^4 \ m^3/$$

$$= \frac{213.8 \times 10^4}{24 \times 60 \times 60} \ \frac{m^3}{s}$$

$$= 24.75 \ m^3/s$$

2.24 Garg (65) ✓ During a particular stage of the growth of a crop, consumptive use of water is 2.5 mm/day. Determine the interval in days between irrigations & the depth of the water to be applied when the amount of water available in the soil is 50% of the maximum depth of available water in the root zone, which is 80mm. Assume irrigation efficiency to be 60%.

Soln:- Given data;

$C_u = 2.5$ mm/day

frequency / Interval (f) = ?

d_w = ? (Actual)

Available water (d_w) = 80 mm

~~η_{effi}~~ = $\eta_{irri.} = 60\% = 0.6$

Here,

Readily available water = 50% of available water

$= \frac{50}{100} \times 80$

$= 40$ mm

Now,

$C_u = 2.5$ mm/day

1-day ← 2.5 mm

? ← 40 mm

$= \frac{40}{2.5}$

frequency(f) = 16-days

After 16-days we need to apply the water

- To find actual depth of water required

$$d_w(\text{actual}) = \frac{R_{AW}\ (\text{Readily available water})}{\eta_{irri}}$$

$$= \frac{4}{0.6}$$

$$= 6.67 \text{ cm}$$

Hence, we need to supply 6.67 cm of water to the fields at an frequency/interval of 16-days

Ex-2.2 (Corg (CO3))

The following data pertains to healthy growth of a crop

Field Capacity = 30%
Permanent wilting point = 11%
Density of soil = 1300 kg/m³
Effective depth of root zone = 700 mm
Daily Consumptive use = 12 mm

For healthy growth, moisture content must not fall below 25% of the water holding capacity between the field capacity & permanent wilting point. Determine the watering interval in days

Soln:-

Given data;

F.C = 30%
PWP = 11%
ρ_d = 1300 kg/m³

$d = 700\,mm = 0.7\,m$

$C_u = 12\,mm/day$

- we know that the maximum water holding capacity is given by

$= FC - PWP$

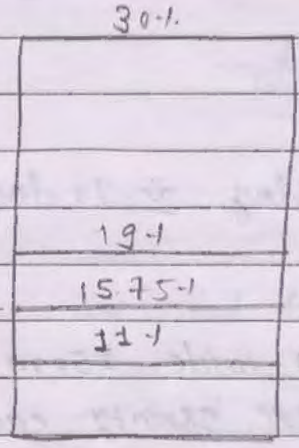
$= 30 - 11$

$= 19\,\%$

- For healthy growth the maximum water holding capacity can not falls down below 25%. So,

25% of max holding capacity $= \frac{25}{100} \times 19\,\%$

$= 4.75\,\%$



Lowes limit up to which water should be falls

Lowes limit of m.c. = PWP + 25% of max. holding capacity

$= 11 + 4.75$

$= 15.75\,\%$

- The m.c will ~~vary~~ allowed to vary between 30% & 15.75%.

Now,

$$\text{Available water } (dw) = \frac{\rho_d}{\rho_w} \times d \times (FC - \text{Lowes limit})$$

$$= \frac{1300}{1000} \times 0.7 \times (0.30 - 0.1575)$$

$$= 0.1297 \text{ m}$$

$$= 129.7 \text{ mm}$$

Consumptive use $(C_u) = 12$ mm/day

1 - day — 12 mm

? — 129.7 mm

$$\frac{129.7 \times 1}{12} = 10.8 \text{ day} \simeq 10 \text{ days}$$

3.8 Punmia (56) An irrigation field of 40m wide 250m long has soil which has apparent spe. gravity equal to 1.56 & field capacity equal to 22%. The depth of root zone is 0.6 m. If the irrigation is started when 70% of water the available water has been used, Compute

a - Net depth of irrigation water required

b - Time required to irrigate the field if the discharge in the field channel is 20 lps.

Soln:- Given data:

Area = width x length
= 40 x 250
= 10000 m^2

G_s = 1.56

F.C. = 22%

d = 0.6 m

d_w = ?

Q = 20 lps (lit/sec)

= 20×10^{-3} m^3/s

= $20 \times 10^{-3} \times 60 \times 60$ m^3/hr

= 72 m^3/hr

- we know that the available water is given by

$$d_w = \frac{\gamma_d}{\gamma_w} \times d \times (F.C. - \text{lower limit})$$

(↳ optimum m.c)

$$d_w = G_s \times d \times (F.C - \text{lower limit})$$

we need to find out lower limit

- Said that the irrigation is started when 70% m.c. is used it means when 30% m.c. is remains in the soil then irrigation is started

Water/Moisture used = 70% of F.C
= 0.70 x 22%
= 15.40%

Water/Moisture remains = 0.30 x 22% = 6.6% = 0

Or

Water/Moisture remains = 22 - 15.40 = 6.6% = 0.066

Therefore, the lower limit = 6.6 l.

- The water fluctuate in between 22 l. & 6.6 l.

Now,

$$r_d = 1.56 \times 0.6 \times (0.22 - 0.066)$$
$$= 0.144 m$$
$$= 144 mm$$

6- Time required to irrigate the field by the discharge of $72 m^3/hr$

Here,

volume of water needed = Area × depth of water applied

$= 10,000 (m^2) \times 0.144 (m)$

$= 1440 m^3$

Now,

$72 m^3$ — 1-hr

$1440 m^3$ — ?

$$= \frac{1440}{72}$$

$= 20$-hrs

* Irrigation frequency / Irrigation interval / Rotation period

- The time interval between two consecu ve (લાગુ કરી) waterings is called irrigation frequency, interval or rotation period
- It is represented by days
- It is vary between 6-15 day for differen crops.

* Classification of ~~reeso~~ regions/zones based on annua rainfall

Arid region

- The area where irrigation must be require for agricultuse is called the arid region.

Semi-arid region

- The area in which inferior (ઓછા) crops ca be grown without irrigation is called a semi-arid region

Average annual Rainfall (cm)	Zone type	% of total are
< 25	Arid	25
25-50	Semi-arid	30
50-100	Sub-humid	20
100-150	Humid	11
150-200	Wet	09
> 200	Very wet	05