Water Requirements of crops

By:

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Water Requirements of crops (WRC)

WRC means the total Quantity and the way in which crops require water from time it is sown to the time it is harvested.

- CROP PERIOD OR BASE PERIOD (B days): The time period that lapses from the instant of sowing to the instant of harvesting is called crop period.
- The time between the first watering of a crop at the time of sowing to its last watering before harvesting is called Base period. B days = Crop period = Base period = Growth period

DUTY AND DELTA OF A CROP

- DELTA: A crop needs a certain amount of water at fixed interval through out its base period. Depth of each watering: 5cm (2’’) -10 cm (4”).
- Def. The depth of water in cm or inches required for the crop through out the base period is called Delta of the crop.
- Ex. Rice :10 cm of water at interval of 10 day. Base period is 120 days. What is Delta of rice?

Values of Delta for certain important crops

S.NO.	crop	Delta	S.No.	Crop	Delta
1	Sugar cane	120 cm (48'')	6	Vegetable	45 cm (18'')
2	Rice	120 cm (48'')	7	Maize	25 cm (10'')
3	Tobacco	75 cm (30'')	8	Wheat	30 cm (12'')
4	Garden fruits	60 cm (24'')	9	Fodder	22.5 cm (9'')
5	Cotton	50 cm (20'')			

Duty of water (D): The duty of water is the relationship between the volume of water and the area of crop it matures.

Volume of water is generally expressed by: a unit discharge flowing for a time of base period of the crop.

1 cu.m per sec or 1 cu.ft/sec of water for B days matures D hectares or acres of land. Then the Duty of water for that particular crop is D hectare/cumecs or D acres/cusecs

Relation between Duty and Delta

- Let there be a crop of base period B days. Let one cumec (m^3/sec) of water be applied to this crop on the field for B days.
- Now the volume of water applied to this crop during B days = V =(24 X60 X 60 XB)m^3 =86,400 m^3
- By definition of duty, 1 m^3 of water supplied for B days matures D hectares of land. This quantity of water(V) matures D ha of land or 10^4 D m^2 of area.
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Total depth of water applied on this land

= Volume/area = 86400 B / 10^4 D = 8.64 B/D m.

By Def. this total depth of water is called Delta Δ

Therefore Δ = 8.64B / D m = 864 B/ D cm

Where Δ is in cm, B is in days,

D is duty in ha/cumec.

In FPS units Δ = 1.98 B / D ft

Where Δ is in ft, B in days and D is in Acres/cusec.

- Example: Find the delta for a crop when its duty is 864 ha/cumec on the field, the base period of this crop is 120 days.
- Solution: Δ (cm)= 864B/D where B is in days and D is in ha/cumec.
- Factors on which Duty depends:
- Assignment: Type of crop, climate and season, Useful rainfall, type of soil and Efficiency of cultivation.

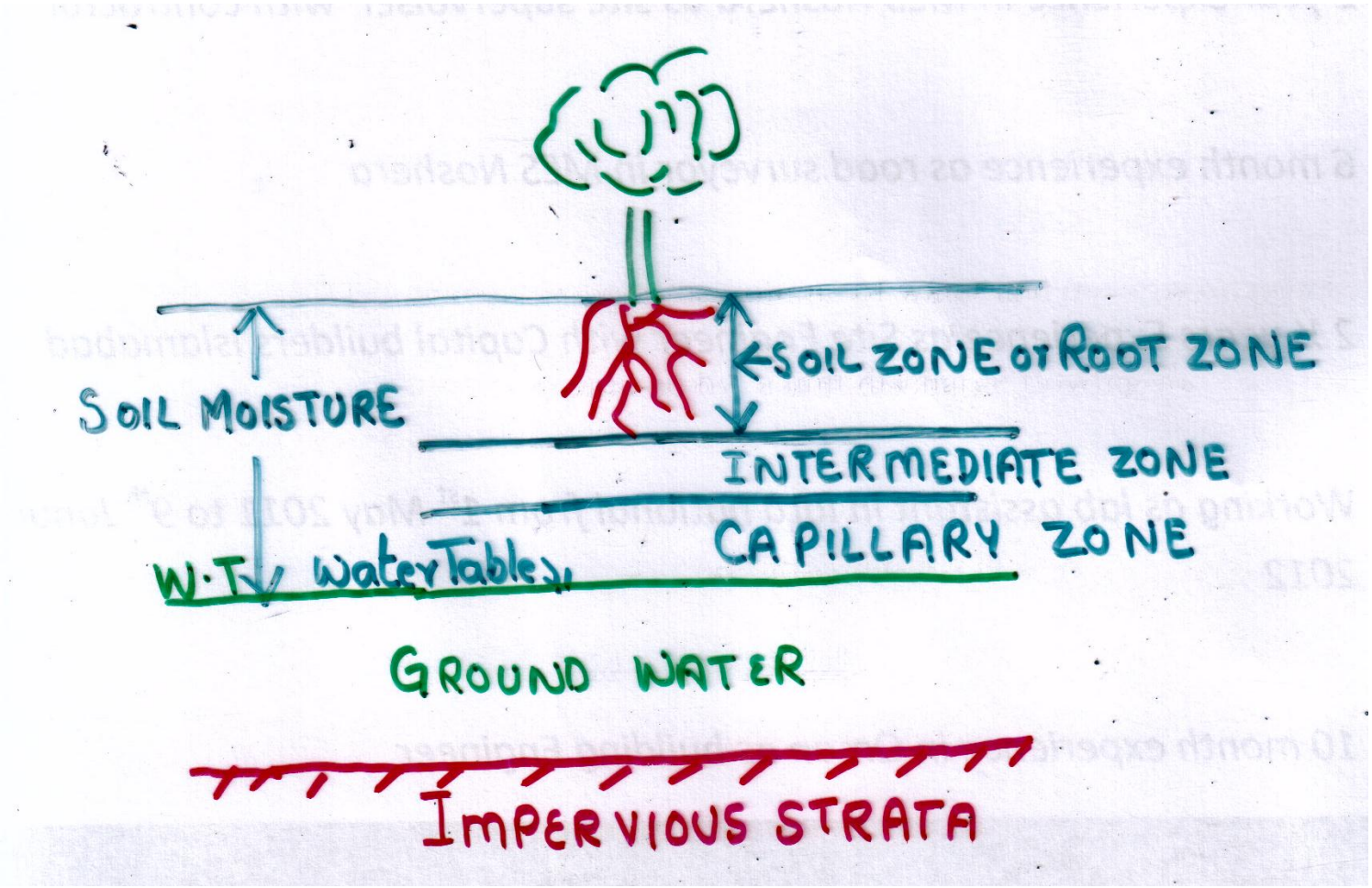
IMPORTANCE OF DUTY

- It helps in designing efficient canal irrigation system. Knowing the total available water at the head of the main canal and the overall duty for all the crops required to be irrigated in different seasons of the year, the area which can be irrigated can be worked out.
- Inversely if we know the crop area required to be irrigated and their duties, we can work out the discharge required for designing the canal.

Q = A/D A=QD

crop	Duty in hectares / cumec
Sugar cane	730
Rice	775
Other Kharif	1500
Rabi	1800
Pernnials	1100
Hot fodder	2200

Soil –Moisture – Irrigation Relationship



Above the water Table: Soil moisture

Below water Table: Ground water

Root Zone: Depth of soil up to which roots are penetrated.

When water falls on ground: Part of the water absorbed by root zone and other part flows downwards by gravity.

FIELD CAPACITY (F.C)

DEF: When all gravity water has drained down to water table, a certain amount of water is retained by surface soil. This water which can not be easily drained under the action of gravity and is called F.C.

Period of drainage = 2-5 days

FC is measured after 2 or 5 days

Field Capacity: 1. Capillary water 2. Hygroscopic water.

1. Capillary water: water attached to soil by surface tension, which can easily be extracted by plants by capillary action.

2. **Hygroscopic water**: water attached to soil by chemical bonds, which can not be extracted by plants by capillary action.

Field capacity = (weight of water retained in a certain volume of soil) / Wt. of same volume of soil) X 100. Consider 1 sq.m area of soil, d m depth of root zone.

Volume of soil = d X 1 Cu.m

If γ Kg/cu.m = density of soil = specific wt. of soil,

Then wt. of d cu.m of soil = γ d kg., If F is Field capacity

F = Wt. of water retained in unit area of soil / γ d

Wt of water retained in unit area of soil =F γ d Kg/ Cu.m

Wt of water retained in unit area or volume= wd1 = γ d. F

d1= depth of water stored in root zone= γ d. F/w =kg/Sq.m/kg/cu.m=m., w = Specific Wt. of water = Kg/cu.m.

Permanent Wilting Point (P.W.P)

A plant can extract water from soil till a permanent wilting is reached. P.W.P is that water content at which a plant can no longer extract sufficient water for its growth and wilts up.

Water Available to plant = Field capacity- P.W.P water

Readily Available Moisture

It is that portion of available moisture which is most easily extracted by plants and is approximately 75 to 80% available moisture.

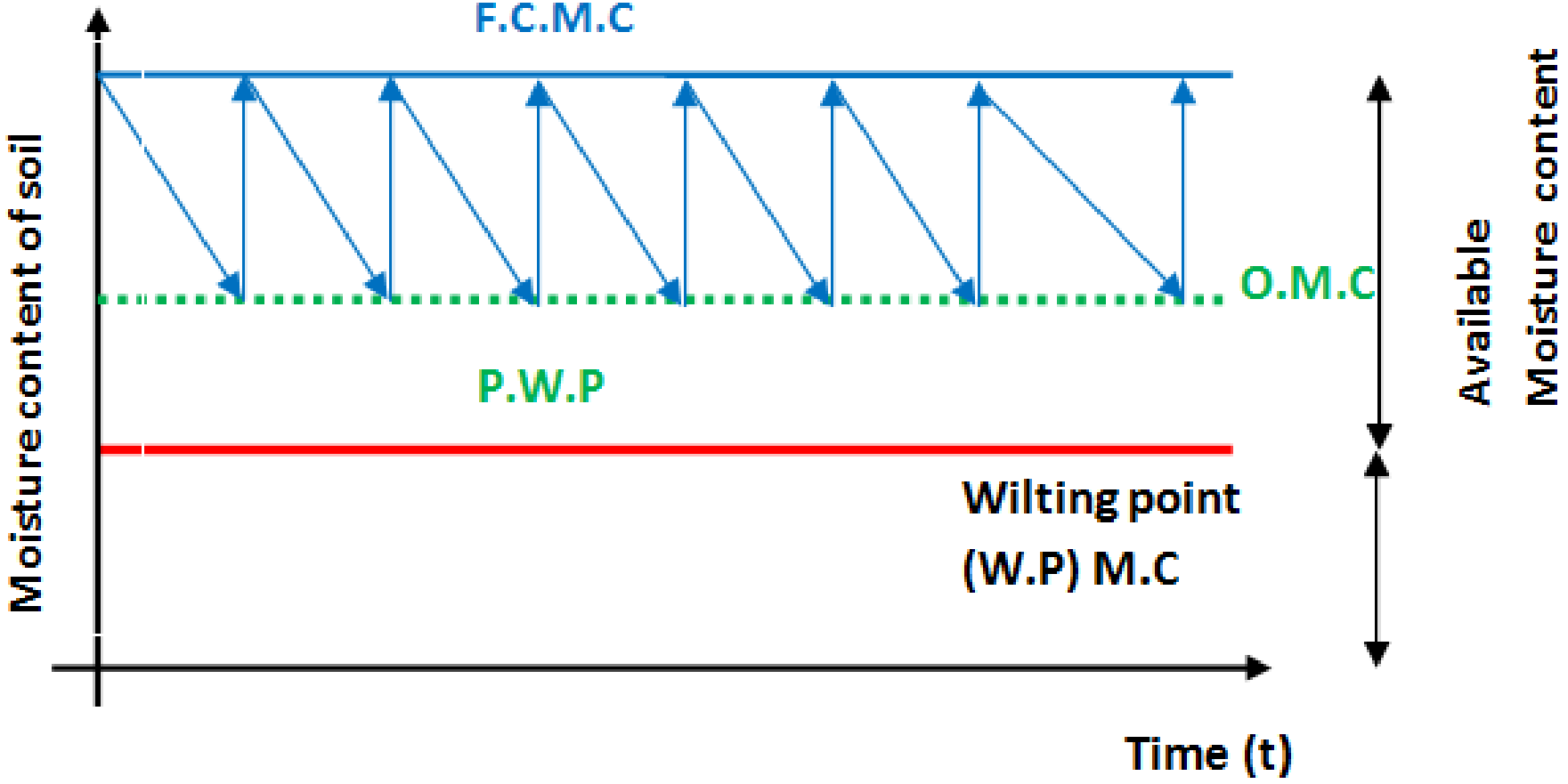
Soil Moisture deficiency (S.M.D)

The water required to bring the soil moisture content of given soil to field capacity is called S.M.D.

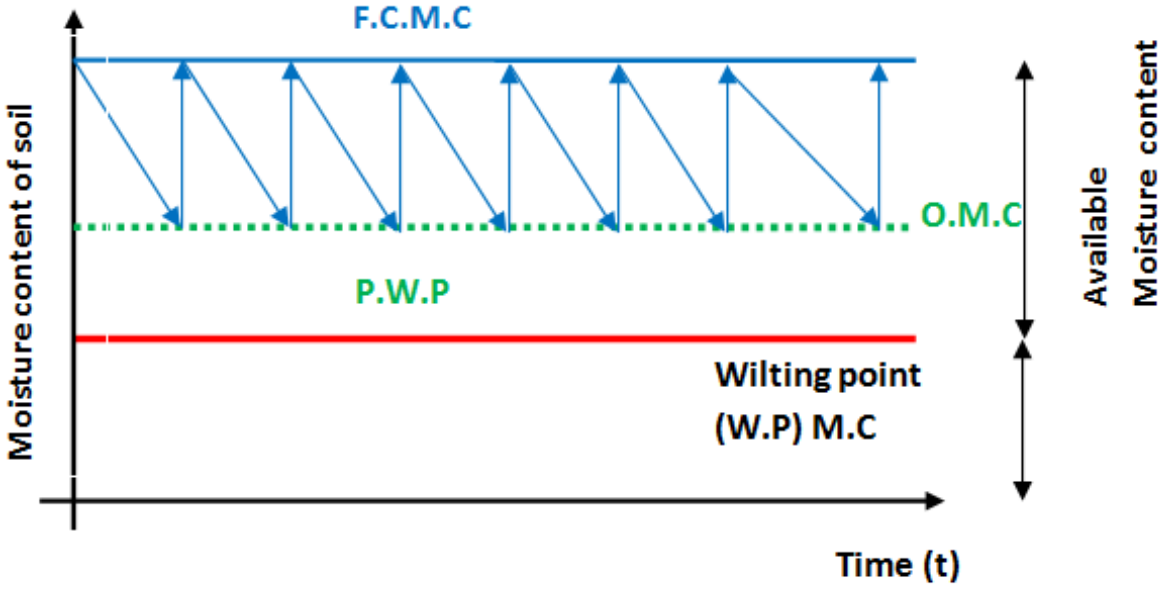
Equivalent Moisture (E.M)

It is the water retained by a saturated soil after being configured for 30 minutes by centrifugal force of 1000 times that of gravity

E.M = field capacity


F.C.M.C
O.M.C
P.W.P
Wilting point
(W.P) M.C
Moisture content of soil
Time (t)
Available
Moisture content

- Water is consumed by plants through roots
- Sufficient moisture should be available in root zone
- Soil moisture in root zone varies from F.C.M.C to wilting point M.C
- Soil M.C is not allowed to deplete up to W.P
- The optimum level up to which the soil moisture content is allowed to deplete is called Optimum Moisture Content (O.M.C)



The irrigation water should be supplied as soon as the moisture falls up to optimum level (i.e. fixing irrigation frequency) and its quantity should be just sufficient to bring the moisture to the field capacity, making allowance for application losses (thus fixing water depth).

Problem:

After how many days, will you supply water to soil in order ensure sufficient irrigation of given crop, if

1- Field capacity of soil = 28 %

2- Permanent wilting point = 13%

3- Density of soil = 1.3gm/cc

4- Effective depth of root zone = 70cm = 0.7m

5- Daily consumptive use of water for a given crop = 12 mm= 1.2cm

Assume readily available moisture = 80% of available of moisture.

Thank You!