5/12/12

⇒ IRRIGATION

- it is the artificial application of water to the crops to increase its productivity in accordance with the total water required for growth of that crop during the crop period.

⇒ Advantages of Irrigation :-

- it increases the food production.
- General developement of a country.
- The canals used for irrigation can also be utilized for inland navigation.
- It helps in avoiding mixed cropping.

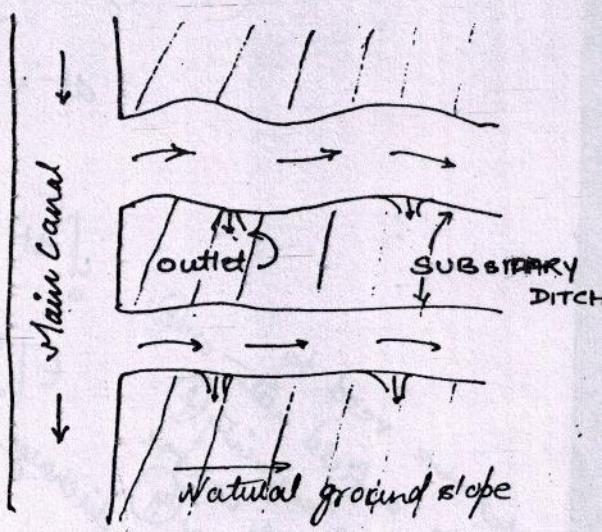
⇒ Disadvantages of Irrigation :-

- It leads to water pollution (due to application of fertilizers).
- Excess irrigation leads to the blocking of the voids of soils. This is termed as the voids of the water logging.

⇒ METHODS OF DISTRIBUTION OF WATER :-

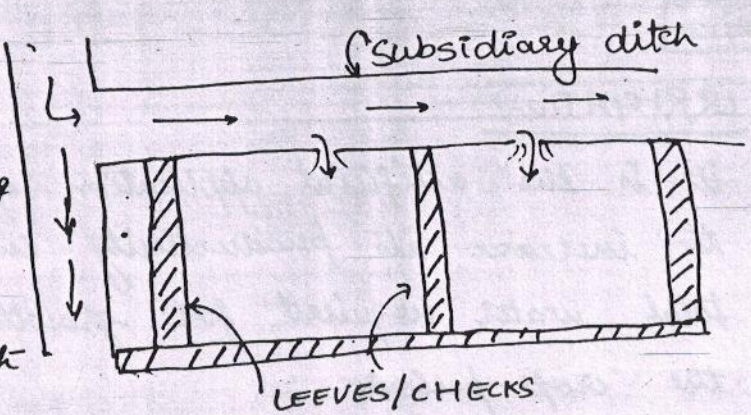
↳ Free flooding / Wild flooding :-

- In this method movement of water is not controlled and hence the water application efficiency is which very less.
- This method is generally adopted for irregular or rolling fields
- This method is suitable for growth of the PASTURES ↳ (animal food)
- This method is very economical.



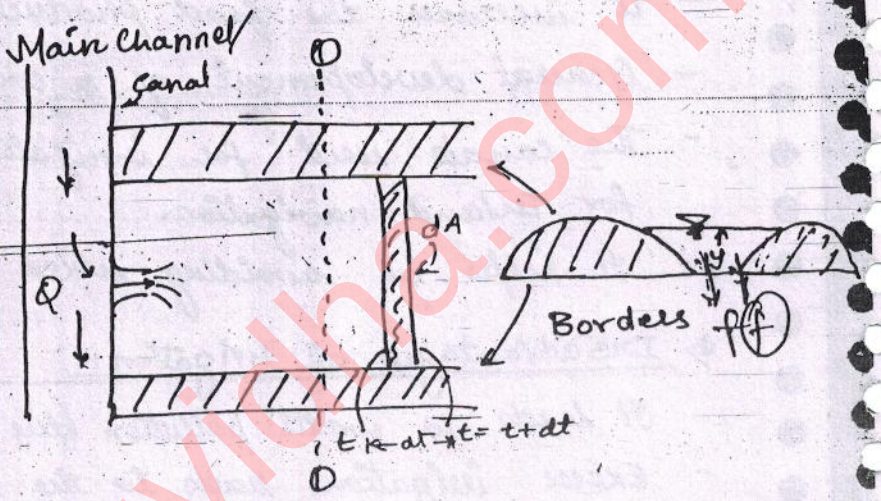
(2) CHECK FLOODING :-

- This method is similar to free flooding with the only diff. that the flow of water is checked with the LEEVES or CHECKS.



(3) BORDER FLOODING :-

- In this method the field is divided into no. of strips which are seperated by borders.



$$\rightarrow \quad Q\,dt = (A+dA)\,dt\,f + y\,dA$$

$$Q\,dt = A\cdot f\cdot dt + dA\cdot dt\,f + y\,dA$$

($dA\cdot dt\,f \to 0$)

$$(Q - Af)\,dt = y\,dA$$

$$dt = \frac{y}{Q-Af}\,dA$$

$$\int_0^t dt = -y\int_0^A \frac{dA}{Af-Q}$$

$$t\Big|_0^t = -y\left|\ln(Af-Q)\times\frac{1}{f}\right|_0^A$$

$$= \frac{y}{f}\ln(Af-Q)\Big|_A^0$$

$$= \frac{y}{f}\ln\left(\frac{Q}{Q-Af}\right)$$

$$\boxed{t = 2.303\,\frac{y}{f}\log_{10}\left(\frac{Q}{Q-Af}\right)}$$

total time reqd to irrigate a field with area (A), infiltration capacity (f) and depth of water on the field as (y) if the discharge is (Q)

→ Maxm. Area which can be irrigated by Given Q (discharge)

$$t = 2.303 \cdot \frac{y}{f} \cdot \log_{10}\left(\frac{Q}{Q - Af}\right)$$

$$\log_{10}\left(\frac{Q}{Q - A \cdot f}\right) = \frac{t \cdot f}{2.303 \cdot y} = K \quad \text{---}$$

$$\therefore 10^K = \frac{Q}{Q - A \cdot f}$$

$$Q = 10^K \cdot Q - 10^K \cdot Af$$

$$A = \frac{Q}{f}\left(\frac{10^K - 1}{10^K}\right)$$

for large values of K. $\frac{10^K - 1}{10^K} = \frac{10^K}{10^K} = 1.$

Maxm Area which can be irrigated by discharge (Q) with infiltration capacity (f) →

$$A_{max} = \frac{Q}{f}$$

Q Determine the time reqd. to irrigate the strip of land of area 0.04 hectare from a tubewell with a discharge of 0.02 m^3/s. infiltration capacity (f) = 5 cm/hr Average depth of the flow in the field is 10cm. Also determine the maxm area that can be irrigated irrigated from this tube well.

Sol

$$t = 2.303 \frac{y}{f}\left(\log_{10}\frac{Q}{Q - Af}\right)$$

$$= 2.303 \times \frac{10}{5} \times 60\left(\log_{10}\left(\frac{0.02}{0.02 - \frac{0.04 \times 10^4 \times 5 \times 10^{-2}}{60 \times 60}}\right)\right)$$

$$t = 39.05 \text{ min}$$

Maxm area = Amax = $\frac{Q}{f}$

$= \frac{0.02}{5 \times 10^{-2}} \times 60 \times 60 \times 10^{-4}$

$= 0.144$ hect

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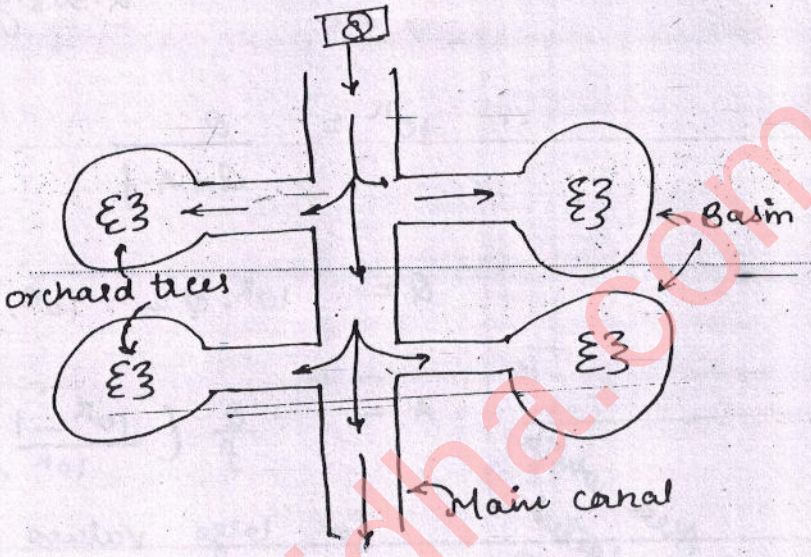
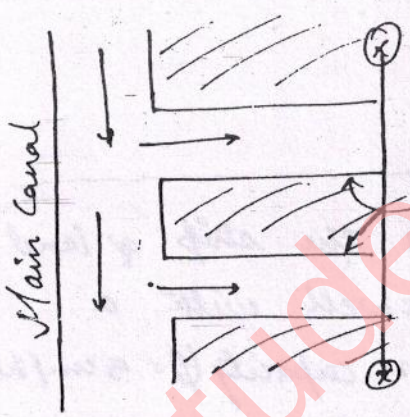
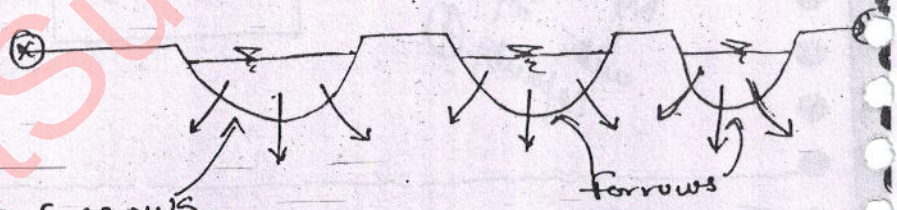
(4) BASIN FLOODING :-

- Basin flooding is the special type of check flooding which is used for the growth of the orchad trees.



(5) FURROW IRRIGATION :-





- In this method instead of wetting the entire area only ($1/5^{th}$ to $\frac{1}{2}$) of the total area is wetted.

Hence the amount of water lost in evaporation and due to percolation is very less.

- This method is more efficient than the previous methods.

(5) SPRINKLER IRRIGATION :-

- In this method water is distributed with the help of network of pumps and pipes.
- In this method the efficiency of water application and water distribution is are very high.
- This method is highly technical method and it very costly.
- This method can be used when there is scarcity of water, when there irregular topography, when the permeability of the soil is very less and when the permeability of the soil is very high.
- The advantage of this method is evaporation and percolation losses are very less.
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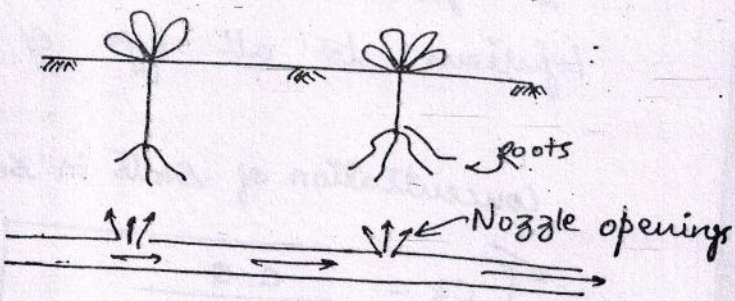
(6) DRIP Irrigation :-

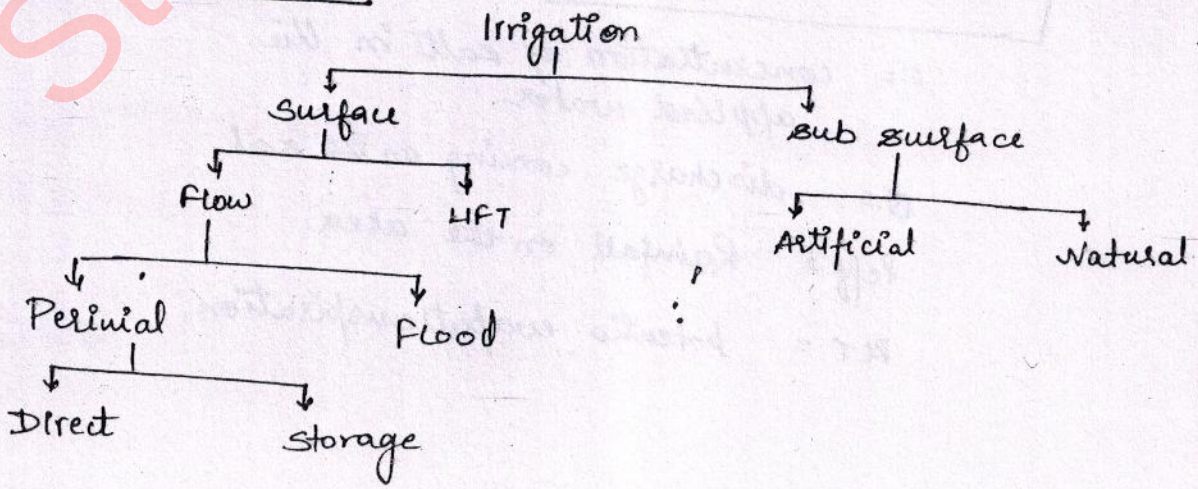
- In this method water is directly applied to roots of the plants with the help of network of drip nozzles.

→ It is highly efficient and loss are very less.

→ Very costly



⇒ Types of IRRIGATION



⇒ QUALITIES OF WATER USED FOR IRRIGATION:

(1) Sediments Present In WATER:-

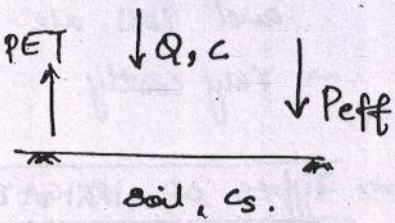
- The effect of sediments present in the water on the field depends upon the soil present on the field.
- If the water is applied on the sandy soil than the sediments increases the fertility of the soil and if these sediments are derived from eroded areas than it decreases the fertility of the soil.

(2) Concentration of Salts In Water:- (Ca^{2+}, Mg^{2+}, Na^{2+}, K^{+})

- Salts of Na, Ca, K, Mg are injurious for the soil if present in high concentration.
- If the concentration of the salts is greater than 700ppm in the water than this water can be used only for certain types of soil and if concentration is greater than 2000ppm than this water is injurious to all type of soils.

Concentration of Salts in soil

$$C_s = \frac{C \cdot Q}{Q + P_{eff} - PET}$$



C = concentration of salts in the applied water

Q = discharge coming on the soil.

P_{eff} = Rainfall on the area.

PET = potentio evapotranspiration.

Imp ⇒ CLASSIFICATION OF WATER On THE BASIS OF SALTS CONC.

Type of Water	Electrical Conductivity in $\mu \frac{mho}{cm}$ at 25°C	Use of Water in Irrigation
C_1 - low alkaline water	100 - 250	- can be used in Irrigation.
C_2 - Medium alkaline water	250 - 750	- can be used after treatment (LEACHING)
C_3 - High alkaline water	750 - 2250	- can be used for some soils after treatment (LEACHING).
C_4 - Very high alkaline water	> 2250	- Cannot be used for irrigation.

(3) Concentration of Sodium ion (cation) w.r.t other cations:-

- If the concentration of sodium ion is high in the water it makes the soil less permeable and increases the pH.
- In general the concentration of Na ion is very less in comparision to other cations [Generally (<5%)] and its proportion is measured by the factor which is known as SAR → sodium Absorption Ratio.

$$SAR = \frac{[Na^+]}{\sqrt{\frac{[Ca^{2+}] + [Mg^{2+}]}{2}}}$$

Here concentration is in Equivalents/million → $\frac{mg/l}{eq.wt.}$

- High sodium soils are highly plastic and sticky when they are wet and they crust very easily when dry
  ↳(cracking)

NOTE

- To reduce the concentration of sodium in soil [Gypsum] is added.
  ↳(Calcium Sulphate)

  By the addition of gypsum, cation exchange process takes place.

Imp → **Classification of Water on the Basis of [Na^+] :-**

Type of Water	SAR	USE in Irrigation
S_1 – low sodium water	0–10	can be used.
S_2 – Medium sodium water	10–18	can be used after treatment
S_3 – High sodium water	18–26	can be used for some soils after treatment.
S_4 – Very High sodium water	>26	Can not be used.

Imp → **Classification of Saline – Alkaline Soils :-**

Type of soil	ESP	EC	pH
SALINE soil	<15	>4000	pH ≤ 8.5
Alkaline soil	>15	<4000	8.5 ≤ pH < 10.5
SALine – Alkaline soil	>15	>4000	pH < 8.5

ESP → Exchangeable Sodium %age.
EC → electrical conductivity (μ mho/cm)

Q. classify the soil if the concentration of Mg, Ca, Na is 1.5, 3 and 2.2 {milli equivalents per litre} → {equi million} and the electrical conductivity is 200 μmho at 25°C. State the problem which may arise in the soil and its remedy.

Sol

as EC = 200 μmho at 25°C

∴ soil is C_1 on basis of salt conc.

$$SAR = \frac{[Na]}{\sqrt{\frac{[Ca]+[Mg]}{2}}}$$

$$= \frac{2.2 \times 10^{-3}}{\sqrt{\frac{3\times10^{-3}+1.5\times10^{-3}}{2}}}$$

SAR = 1.46

∴ soil is S_1. → soil S_1-C_4 alkaline as Ec<400

* ~~CROP~~ ~~REQ~~