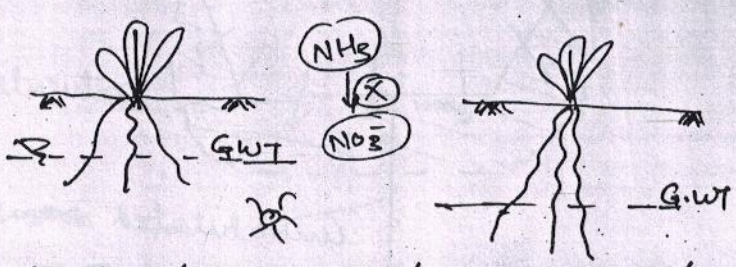
⇒ WATER LOGGING & SOIL RECLAIMATION



- An agricultural land is said to be water logged when its productivity gets effected by the high water table.

→ Effects of water logging :-

1) It reduces the productivity of the crop.
Because the nutrients like nitrates decrease due to the shortage of oxygen present in the soil in the root zone due to increased water table.

→ Nitrate is converted from ammonia by the by the aerobic mlo which survive in the presence of oxygen.

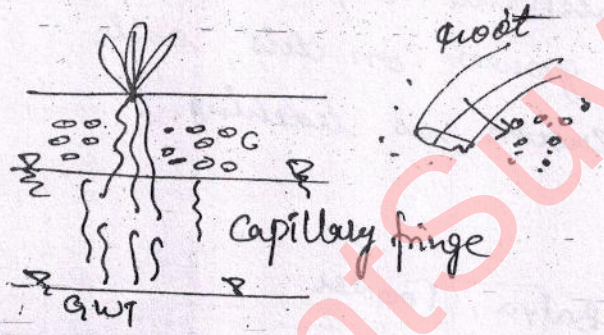
- Due to rise in G.W.T. there is shortage of oxygen in the soil present in root zone.
- Hence these mlo are not able to carry out the nitrification process.

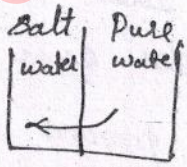
2) Increase in salinity of soil.

- if the water table comes in the root zone or if the plant roots comes in the capillary fringe water is countinously evaporated by the capillary action.

- Hence there is countinous flow of water from the water table to the surface.
- Salts like NaCl, Na_2CO_3, Na_2SO_4 which are dissolved in the water rise to the surface along with the water.
  Resulting in increase concentration of the salts in the root zone.
- If the concentration of salts exceeds a particular point it reduces the osmostic activity of the plant and finally resulting in the death of the plant.

NOTE :- If the salinity of the soil is increased, it becomes ill aerated and finally becomes alkaline.





osmosis process.

Na_2CO_3 – Black alkali

→ METHOS TO PREVENT WATER LOGGING

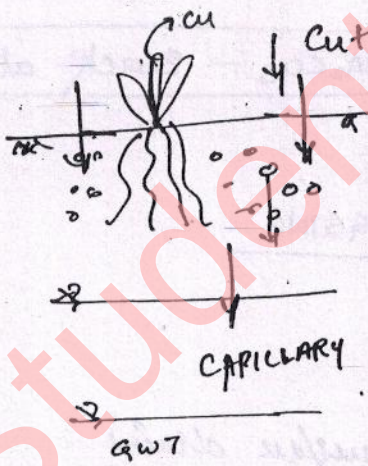
1) By lining the canal
2) Extensive irrigation
3) By providing surface and sub surface drains

→ **SOIL RECLAIMATION**:-

- Before reclaiming the soil, all the measures for controlling the water logging are adopted. Once the water table falls below the root zone depth, the salt concentration in the soil is reduced by the process known as leaching.

→ **LEACHING**

- In this process, the land affected is flooded with the adequate depth of water which moves down to meet the GWT. and carries the salt present in the soil along with it.
- When the concentration of the salt is reduced to such an that salt resistant crops such as Bajra and fodder can be grown on this soil. This full process is known as leaching.



Bajra, Foodel

$S_4 \rightarrow S_3 \rightarrow S_2 \rightarrow S_1$

LEACHING REQUIREMENTS :-

- it is defined as the amount of water reqd. to carry out the leaching operations.
- It is the ratio of depth of water drained out per unit area to the depth of irrigation water applied per unit area.

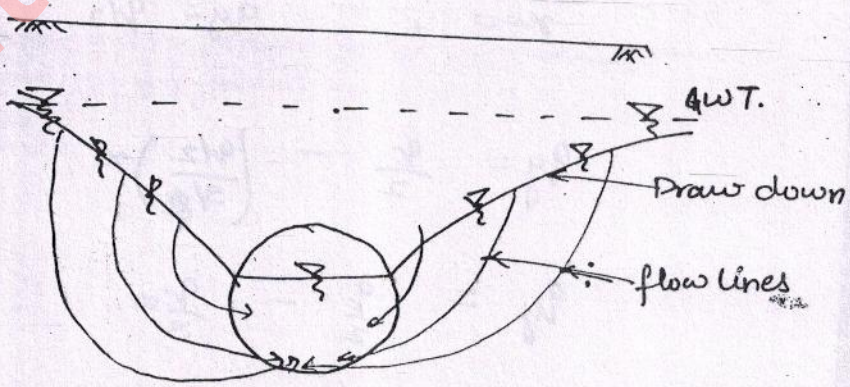
→ Leaching Requirements

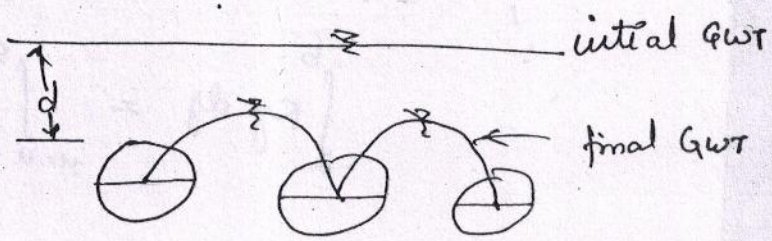
$$LR = \frac{Dd}{Di}$$

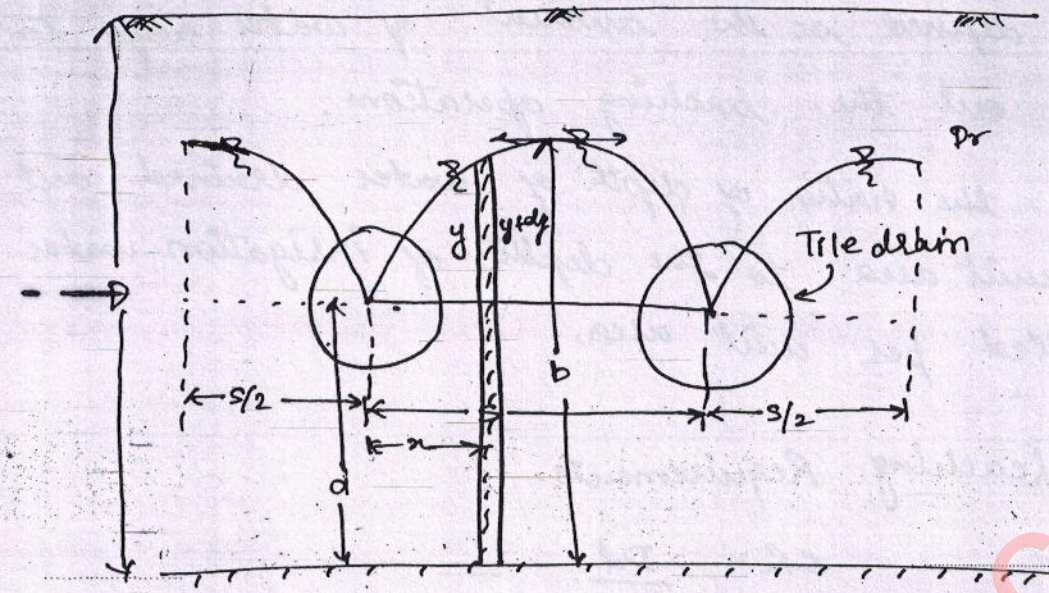
$$Di = Dd + Cu$$

$$\boxed{LR = \frac{Di - Cu}{Di} \text{ or } \frac{Dd}{Dd + Cu}}$$

→ SUB-SURFACE DRAINS / TILE DRINS :-







D = Depth of impervious layer below G.L.

q = discharge carried by a tile drain.

as per darcy's law

$$q_y = KiA$$

$$= K \frac{dy}{dx}(y*1)$$

$x = s/2$, $q_y = 0$

$x = 0$, $q_y = q/2$

$$q_y = \frac{q}{2} - \left(\frac{q/2}{s/2}\right)x$$

$$q_y = \frac{q}{2} - \frac{q}{s}x.$$

$$\frac{q}{2} - \frac{q}{s}x = K y \frac{dy}{dx}.$$

$$\int_d^b K y\, dy = \int_{x=0}^{s/x} \left(q/2 - q/s\right) dx$$

$$\left(\frac{q}{2}x - \frac{q}{2S}x^2\right)_0^{S/2} = K\left|\frac{y^2}{2}\right|_a^b$$

$$\frac{q}{2}\left(\frac{S}{2} - \frac{S^2}{4S}\right) = \frac{K}{2}(b^2 - a^2).$$

$$\frac{qS}{4} = K(b^2 - a^2)$$

$$\boxed{q = \frac{4K}{S}(b^2 - a^2)}$$ Discharge in the tile drains.

a = height of the centre of tile drain above Impervious layer.

b = Highest depth of drawdown curve above impervious layer.

Note:- for most of the crops, water table must be atleast 1 to 1.5m below the ground level and the drains are placed atleast 0.3m below the highest level of the water table.

$\Rightarrow b = (D - 1 \text{ or } 1.5)$

$a = (b - 0.3)$

- These tile drains are designed to carry the discharge normally equal the 1% of the annual average rainfall of that place and is drained by this tile in 24 hrs.

if P_{an} – annual avg rainfall.

$$q = \frac{P}{100} \times A = \frac{P}{100} \times \left[\frac{\left(\frac{S}{2} + \frac{S}{2}\right) \times 1}{24 \times 60 \times 60}\right] \times \frac{1}{100}$$

$$\boxed{q = \frac{P}{104}\left(\frac{S}{2} + \frac{S}{2}\right) \times \frac{1}{24 \times 60 \times 60}}$$

This can be equated to the eqn of q above and Value of (A) & (B) can be calculated.

⇒ DRAINAGE COEFF:-

- defined as the rate at which the water is drained out by tile.
- it is expressed in terms of depth of water to be drained in 24hrs.

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Q In a tile drainage system the drains are laid with centre 1.5 below the ground. The impervious layer is 9m below the ground. The annual average rainfall in the area is 80 cm. If 1% of annual average rainfall is to be drained in 24hrs to keep the highest point of the water table 1m below the G.L. Determine the spacing of tile drain and size of the drain if coefficient of permeability is 0.001 cm/s and N = 0.011. Tile grade is 0.3%. (i.e $\frac{1}{33}$)

Sol

$a = 9 - 1.5 = 7.5$; $K = 10^{-5}$

$b = 8m.$

$N = 0.11$

$S = \frac{1}{33}$

$$q = \frac{80}{100} \times \left[\frac{1}{100}\right] \times [1 \times S] \times \frac{1}{24 \times 60 \times 60} \quad \text{—(1)}$$

$q = \quad m^3/s$

$$q = \frac{4K}{S}(b^2 - a^2) = \frac{4 \times 10^{-5}}{S}(8^2 - 7.5^2) \quad \text{—(2)}$$

from eqn (1) & (2)

$S = 57.86m$

$$\therefore \quad q = \frac{4 \times K}{S}(b^2 - a^2)$$

$$= \frac{4 \times 10^{-5}}{57}(8^2 - 7.5^2)$$

$q = 5.36 \times 10^{-6}$ m³/s /m of length.

$q = A \cdot V$

$$5.36 \times 10^{-6} = \frac{\pi D^2}{4} \cdot \frac{1}{N} \cdot \left(\frac{D}{4}\right)^{2/3} \times (S)^{1/2}$$

[take full depth of flow, as it is water. $\therefore \left(R = \frac{A}{P} = \frac{D}{4}\right)$

$D = \underline{8.9\text{mm}}$.

Q Sugarcane having the root zone depth of 1.8m is grown ~~un~~ in a particular area where the GWT. 2m below the G.L. If the size of the pores of the soil is 0.08mm in dia and surface tension is 0.054 N/m. Is the field water logged, if so determine the vertical location of the closed drain below the ground spaced at 15cm. Take the drainage coefficient as ~~0.6 0.116 qmax/km~~ 0.116 cumecs/Km.

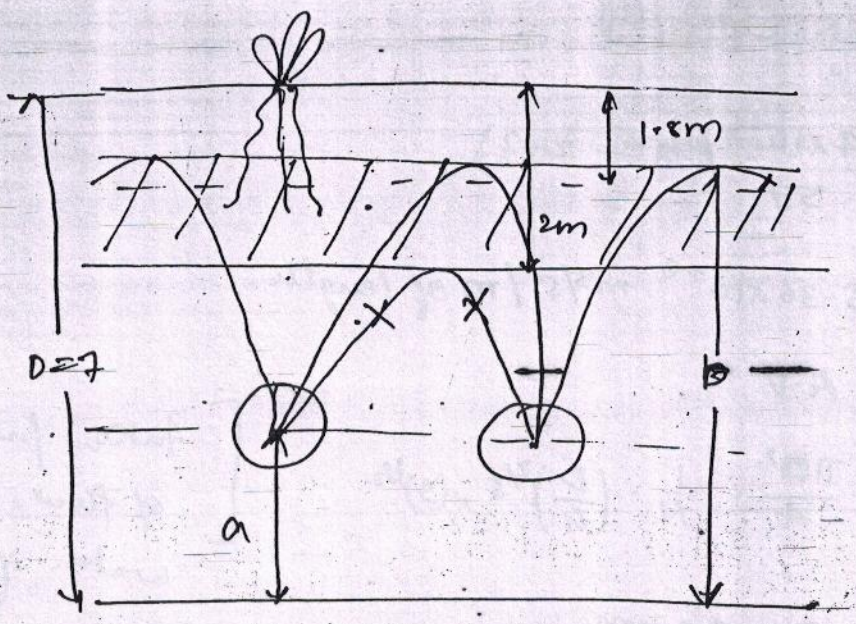
~~K~~ = coefficient of permeability 10^{-6} m/sec.

And impervious stratum is 7m below the Ground.

So The root zone may be in capillary fringe.

$$h_c = \frac{4T\cos\theta}{\gamma_w \times d} = \frac{4 \times 0.054 \times 1}{9810 \times 8 \times 10^{-5}} = \underline{0.275\text{m}}$$

(Note) for (b) the WT is already below the root zone but the capillary fringe is in the root zone so the drain ... will be at the capillary height



$b = 7 - 1.72 = 5.28m$.

$Dc = 0.116$ cumec/sec

$$q = \frac{0.116}{10^6}(5\times1) = \frac{4K}{\delta}(a^2-b^2)$$

$$\frac{0.116}{10^6}\times 15\times10^{-2} = \frac{4\times10^7}{15\times10^{-2}}\left(5.28^2 - a^2\right).$$

$$\therefore a = 5.279m$$