

Define crop physiology & scope and importance.

1) Crop physiology -

Crop physiology can be defined as systematic application of knowledge of natural processes occurring in crop plant and fundamental principles of plant physiology for efficient crop production.

• Scope and importance of crop physiology.

Scopes: 1) All the processes within the plant are the manifestation of what we call life.

2) It is the object of life processes of life of crop physiology, to study, investigate, invent the all life processes of crop.

3) This involves the study of various plant organ tissues.

4) This knowledge can be used in enhancing crop improvement & increase crop production.

Importance:

1) Use of knowledge of plant nutrition.

2) Knowledge about deficiency, symptoms.

3) Use of knowledge of plant water relations.

4) Use of growth principle.

5) Use proper growth retardants.

6) Use of knowledge of phytohormones.

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Q. What is absorption of water? Explain factors affecting it.

Absorption of water -

The water is absorbed by the plant to make it in nutritional part of plant is known as absorption of water.

The absorption takes place in the terminal portion of roots but the maximum absorption of water takes place in root zone of root hair.

Absorption of water is classified into two types

- i) Active absorption
- ii) Passive absorption

Active absorption - Root and root hairs play an active role for absorption of water. The absorption of water occurs by osmotic & non-osmotic processes.

Passive absorption -

Passive absorption occurs due to the activity of upper parts of the plants such as shoot and leaves.

In passive absorption aerial parts of plant play an important role by the process of transpiration.

• Factors affecting the rate of absorption

1) Environmental factors

- i) Available soil water
- ii) Concentration of soil solution
- iii) Soil aeration
- iv) Soil temperature

2) Plant factors

- i) Transpiration
- ii) Absorbing root system
- iii) Metabolism

1) Environmental Factor

i) Available soil water

In the soil various type of water present i.e. hygroscopic, gravitational, capillary etc. In which capillary water is easily absorb by the plant. If amount of water is increases than field capacity it create bad effect on soil aeration and also affect the soil absorption.

ii) Conc. of soil solⁿ.

Large no. of elements are dissolved in soil water is called as conc. of soil solⁿ. If the solⁿ is highly concentrated then osmotic pressure is increases & when it reaches higher of cell sap, water is not absorbed.

iii) Soil temperature.

The variations of temperature is affects rate of soil absorption, 20-30°C is the temperature suitable for absorption. The low temp. reduces absorption while high temp. increases rate of absorption.

iv) Soil aeration

Absorption of water by the roots take place at a rapid rate in well aerated soil & absorption of water greatly retarded in soils which are deficient in oxygen supply.

2) Plant Factor Internal envt factor

i) Transpiration-

The rate of absorption of water is nearly directly proportional to that transpiration. That's the rate of absorption increases, transpiration rate is approximately increases.

ii) Absorbing root system -
 Root system also affect the absorption of water. Those plant which possess hairy & well developed root system show higher rate of water absorption.

iii) Metabolism
 Metabolism activities are expected to participate indirectly by forming a constant located root system and always providing newer contacts with soil water.

Q. Define ascent of sap. Enlist and explain the theories of ascent of sap.

Ascent of sap -

The upward movement of water from the root system to the aerial parts of the plant through the xylem is known as ascent of sap.

Mechanism of the theories of ascent of sap.

1] Vital theories

- i) Relay pump theory
- ii) Pulsation theory

2] Root pressure theory

3] Physical Force theories

- i) Atmospheric pressure theory
- ii) Imbibition pressure theory
- iii) Capillary theory
- iv) Cohesion of water & transpiration pull theory
- v) Jasmin's chain theory.

7] Vital theories - Living cells are present in these theories

1) Relay pump theory.

- The relay pump theory was proposed Godlewski in 1884 for ascent of sap.
- According to this theory the living cell of xylem pump the water upward.

2) Pulsation theory -

- Sir J.C. Bose was the Indian scientist who proposed this theory.
- According to him, ascent of sap takes place due to the pulsation activity of living cells of the innermost contricle layer.
- According to this theory cell absorb the water from outside & pump the same to the vessel.

2] Root pressure theory

- According to this theory, the ascent of sap is due to hydrostatic pressure developed in roots by the accumulation of absorbed water.
- This theory is proposed by Priestley Stocking (1950)

3] Physical force theories -

- Living cells are not involved in this theories.
- Physical force theories states that dead cells of xylem are responsible for ascent of sap.

1) Atmospheric pressure theory -

- This theory was proposed by Boehm (1800)
- Ascent of sap takes place due to atmospheric pressure but it is not accepted because.

i) Atmospheric pressure can't act on water present in xylem in roots.

ii) Atmospheric pressure can't raise water beyond 34 feet.

2) Imbibition theory -

• It was proposed by Unger & supported by Sachs (1878)

• According to him, ascent of sap takes place by imbibition through cell wall of xylem.

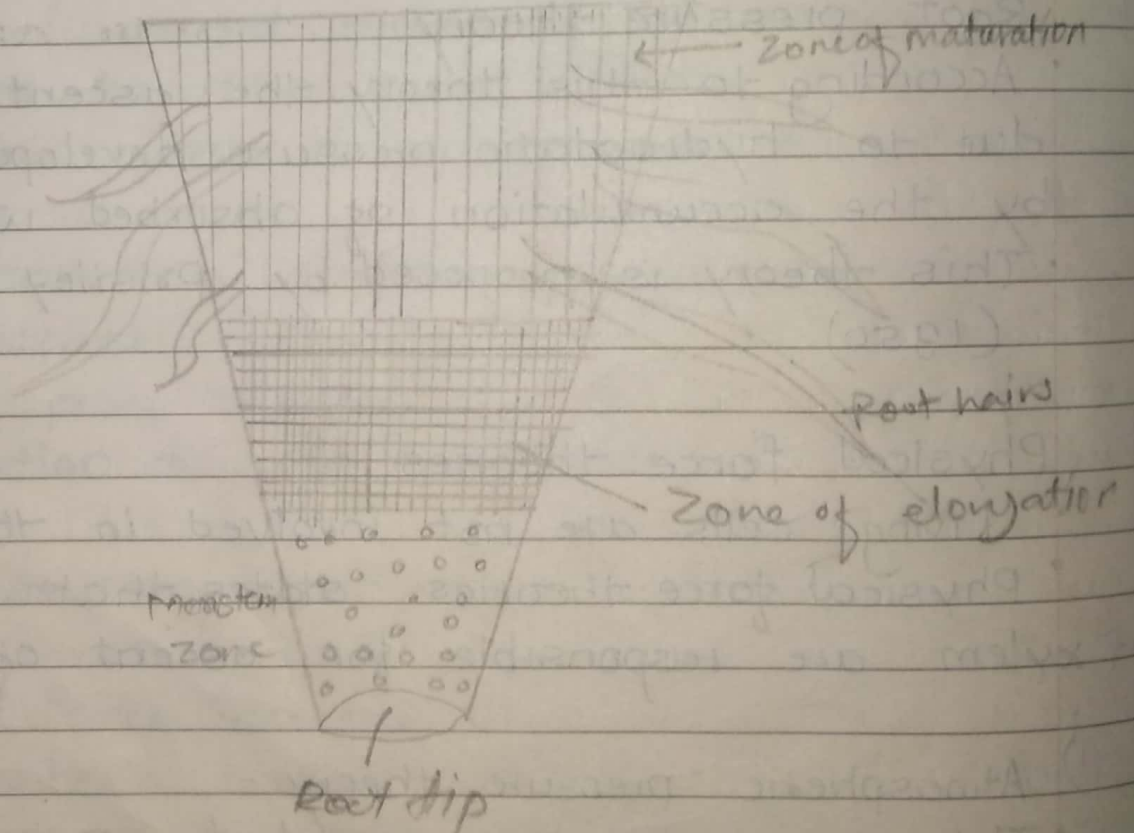
3) Capillary theory -

• Boehm (1809) proposed this theory.

• This theory states that water rises in narrow tubes due to surface tension.

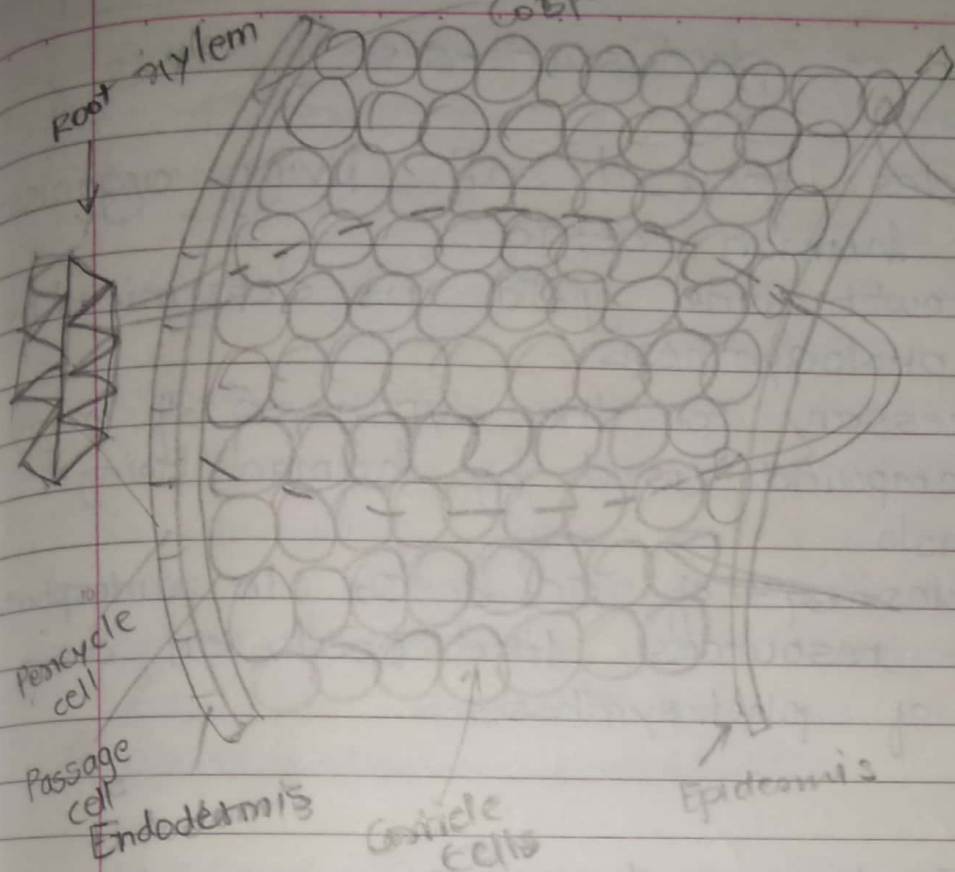
4)

Q. structure of root and root hair



Structure of root hair

Q. Explain pathway of water with suitable Diagram



Pathway of water in root hair

Pathway of water in root hair -

- The water is absorbed by the soil from root hair cells.
- The water reaches the leaves by passing through a no. of cell from the root hair cell.
- The water reaches endodermis, the endodermal cell is called passage cells.
- The water from the pass into the pericycle cells.
- From the pericycle cells water passes into xylem cell.
- Through the xylem tubes water moves upward to leaf xylem.
- The root hair and xylem cells are in a line to facilitate easy movement of water.
- The water movement from the one cell to another is brought about by the turgor pressure.

Q. Explain factors affecting on photosynthesis & Significance of photosynthesis.

- 1) It provides food to all living organisms including human being
- 2) Plant growth and yield are determined by rate of photosynthesis
- 3) It is necessary for the synthesis of many organic compound used by human being & other animals.
- 4) It maintains eq^m of CO_2 & O_2 in atmosphere
- 5) Energy resources like coal, oil are outcome of photosynthesis

Factors affecting photosynthesis

1] External factor

a) Radiation and light

The radiation coming out of sun should be optimum or attaining the minimal rate of photosynthesis

Light also affects rate of photosynthesis. If light intensity is 3000nm containing red light with duration of 10 to 12 hrs per day then there is maximum rate of photosynthesis.

[If the proportion of light hits minimum level, rate of photosynthesis decreases is called as light saturation point.] Also at a particular light intensity utilization is maximum which is called as light compensation point.

2) Temperature

If the temp^r increases rate of photosynthesis increases & vice versa.

The maximum photosynthesis occurs in betⁿ 25 - 35°C and it ceases above 45 - 50°C

3) Effect of CO₂ conc.

The ideal conc. of the CO₂ in atmosphere is 300 ppm. Crop manufacture food with the help of photosynthesis and ideal proportion of conc. around crop canopy. If percent of CO₂ is increases above minimum level rate of photosynthesis decreases.

4) Effect of water or soil moisture

Water is aids the turgidity of the cell for maintaining different metabolic process in plants. A moisture level in the soil should be above 30% to carry out regular metabolic activities.

5) Effect of turbulance

The movement of CO₂ is static early in the morning but slowly it increases upto evening cause of availability of CO₂ increases and rate of photosynthesis also increases.

6) Effect of O₂

If the conc. O₂ increases the rate of photosynthesis decreases and vice versa.

7) Mineral elements.

Some elements plays an imp. role in the

process of photosynthesis being component of chlorophyll pigment or required for light reaction of photosynthesis.

Copper (Cu), Manganese (Mn), Iron (Fe), Magnesium (Mg) Phosphorous (P)

II] Internal factor

1) Protoplasmic factor

The components related to protoplasm plays an important role in dark reaction of photosynthesis

2) Leaf anatomy

A characters like leaf size, chlorophyll content, no of stomata, leaf orientation, leaf age are some of the factors which are responsible for photosynthesis.

3) Accumulation of carbohydrates

If the stored food is not utilized properly for nourishment of crop, the demand of food is lowered and it affect the rate of photosynthesis.

4) Phytohormones

The rate of photosynthesis is regulated by plant hormone system GA & cytokinins increase photosynthetic rate

Absorption & Translocation of minerals salts

Ans - Absorption of mineral salt -

Minerals & salts nutrition are absorbed or gained by root zone from soil, is called absorption.

Translocation
~~Absorption~~ of mineral salts.

Downward translocation through phloem & upward translocation through xylem inside the plant is called translocation of mineral salts. Translocation of mineral salts through pore spaces between diff. cells is called apoplastic movement & across the cell called symplastic movement.

In soil group of soil particles or mass of soil particle which is aggregated is called claymycelle. Claymycelle is limiting charge attract positive ions there after these positive ions attracts -ve ions and then it is absorb by root system. Monovalent cations are rapidly absorb an bivalent cation

Types of absorption of mineral salts

1) Passive absorption / physical absorption

This is a type of absorption without expenditure of the energy. Passive absorption can be explained with different theories.

1) Outer free space theory
 Salt absorption occurs through intimate contact of root system with the soil solution. There is a free movement of cations & anions till the ion concentration in tissue is equal to ion concentration in soil solution.

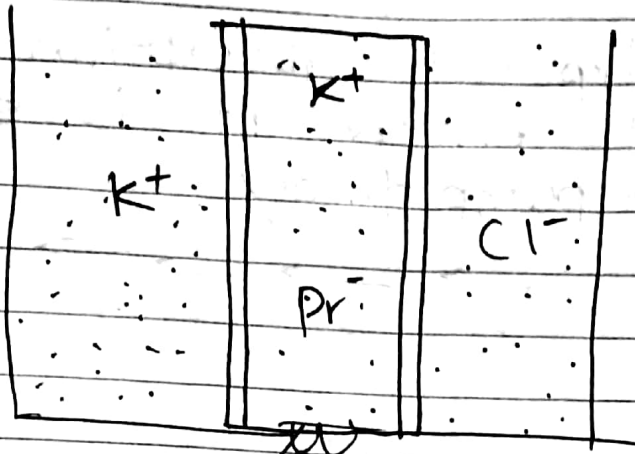
2) Mass flow theory
 It is movements of ions along with mass flow of water under influence of transpiration.

3) Ion exchange theory
 There are two types first contact exchange

1) Contact exchange
 It is type of ion exchange betⁿ root & clay mycelle without operation of soil solution.

2) Carbonic acid theory
 In this type soil solution play an important role. There is a reaction in between CO_2 released from roots & water in the soil to form carbonic acid H_2CO_3 . The reflexes of H_2CO_3 to clay surface takes place the H^+ cations replace K^+ cation. & clay particles become acidic. KHCO_3 is formed returns to the soil surface again K replace H enters into the root as an ion pairs.

4) Donnan's equilibrium

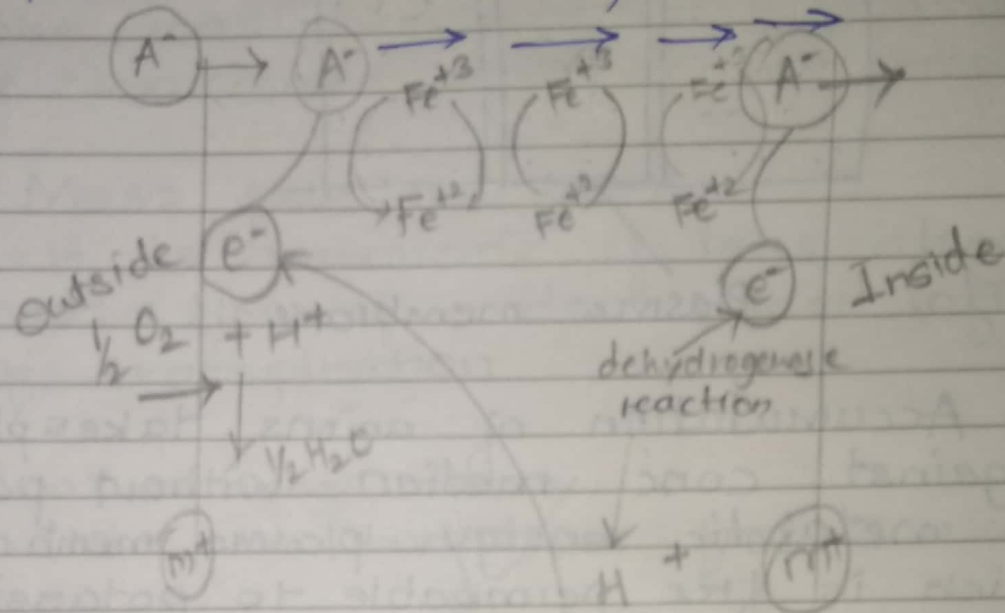


Plasma membrane

Accumulation of anions takes place against conc. gradient without participation of metabolic energy. Plasma membrane which is free permeable to potassium & chloride but impermeable to proteinase Pr^- which are fixed anions. Equal no. of potassium & chloride will diffuse into the cell across the membrane till eq^m. At the eq^m, concentration of potassium inside the cell will be greater than outside because additional cations K^+ needed to neutralise Pr^- anions. This results into accumulation of cations in the cell at higher concentration than external & solⁿ without expenditure of energy.

Active absorption of mineral salts

It is type of absorption with expenditure of energy it is explained by cytochrome pump theory.



- 1) Dehydrogenase reaction on inner side of the membrane give rise to proton H^+ & electron e^- .
- 2) The electron travels over the cytochrome chain towards outside of the membrane so that Fe^{+3} reduce to Fe^{+2} on outer surface.
- 3) On the outersurface the reduced cytochrome is oxydised by O_2 releasing the electron & taking an anion m^+
- 4) The electron release unite with H^+ & Oxygen to form water.
- 5) The anion travels over cytochrom toward inside
- 6) On the inner surface oxydised cytochrome becomes reduced by taking an electron

produced through dehydrogenase reaction & anion is release.

7) As a result of anion absorption cation m^+ moves positively outside to inside to balance the anion.

Imp ***

Differentiate between Non cyclic & Cyclic photophosphorylation.

Non cyclic	Cyclic
1) It is dependent on both PS-II & PS-I	1) Dependent on only PS-I.
2) Presence of mixed light i.e. long & short wavelength.	2) Monochromatic light of longer wavelength.
3) ATP is produced when movement of electrons from PS-II to PS-I	3) ATP production when movement of electrons from PS-I to PS-I
4) Products are $\frac{1}{2} O_2 + ATP + NADPH_2$	4) Product is 2ATP.
5) Photolysis of water reqd.	5) No need of photolysis of water.
6) Water molecule is the source of electron which helps the chlorophyll molecule to come to ground state	6) Electrons comes from P700
7) The electron does not complete the cycle, starts from PS-II & drained off in carbohydrates produced	7) Electron moves from P700 to P700 through 2 to 3 transfer steps to decrease redox potential.

by CO_2 reduction.

- | | |
|---|--------------------------------------|
| 7) Oxygen is evolved. | 8) Oxygen is not evolved. |
| 9) Found in green plants. | 9) Found in photosynthetic bacteria. |
| 10) Stopped by DCMU
(Dichloro dimethyl urea) | 10) Not inhibited by use of DCMU |

Water use efficiency (WUE)

Water efficiency -

It is the amount of dry matter produced per unit amount of water transpired and expressed as gm per kg.

Factors affecting (WUE) Water use efficiency.

1) Climatic factor

a) Solar radiation -

The intensity of solar radiation affects the rate of evapotranspiration and ultimately WUE.

If the intensity of solar radiation increases ET also increases and improves water use efficiency.

b) Humidity -

If humidity decreases evapotranspiration also increases and water use efficiency decreases.

c) Wind -

High wind velocity increases evapotranspiration but beyond the limit decreases WUE.

d) Temperature

High temperature increases evapotranspiration and improves WUE.

There are common

e) Edaphic factor

It includes type of soil, soil structure, soil texture, soil temperature, field capacity,

water holding capacity of soil.

f) Plant Factor

It consist of leaf characteristics like leaf area, no. of stomata etc.

g) Agronomic factor.

Row spacing, row direction, continuous and skip rows

h) Cropping pattern -

Sole, mixed and intercropping

Measures

Factors for improving WUE

1) Timely sowing -

Timely sowing of crop insures proper temp and other soil physical conditions favouring optimum crop growth. If sowing is delayed the competition with weed, infestation of pest and disease occurs.

2) Depth of sowing

Affect seedling emergence, vigour and yield

3) Plant population -

Plant population influence WUE by influencing interception and utilization of solar energy.

4) Anti-transpirants -

Use of anti-transpirants which is applied on the plant to reduce rate of transpiration. ABA, Wax, salicylic acid, phenyl-mercuric acid

5) Use of mulches -

Conservation of water upto 10-15% by using mulches improves water use efficiency.

6) Use of growth retardants -

In some crops growth retardants are used to control vegetative growth of crop and converting into reproductive growth restricts the rate of transpiration and improves water use efficiency.

7) Use of shelter-belts -

Plantation of heighted trees along the borders of field avoids the hot winds to enter into the field reduces ET and improves WUE.

8) Method of irrigation

Modern irrigation methods like drip irrigation & sprinkler irrigation should be used to apply reqd. quantity of water at proper place for improving absorption and utilization of water and ultimately WUE.

9) Fertilizer application

Integrated fertilizer management (IFM) is important for improving water use efficiency by considering quantity of fertilizer, method of fertilizer application and time of fertilizer application.

10) Weeds and their control -

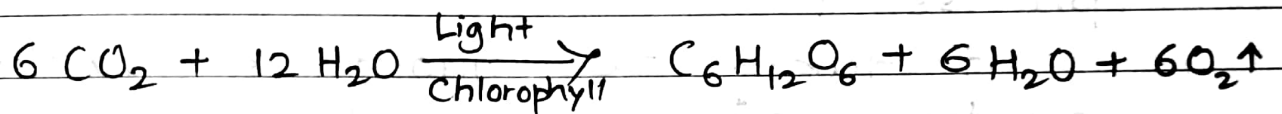
Weeds compete with the main crop for food, water and sunlight. WUE can be improved by controlling weeds in the field.

11) Insect, pest & disease -

This factor causes 40% economic loss of a crop and also increases water requirement there by reducing WUE.

• Photosynthesis -

Photosynthesis is a process in which certain carbohydrates are synthesized from CO_2 & H_2O by chlorophyllous cell in presence of light and oxygen being by product.



• Different types of photosynthetic pigments

Photosynthetic pigments

