

B.Sc. IIIrd Sem, Rural Technology

AS-2985 "Plant Physiology & Biochemistry"

BOTANY - Paper - II (RTB-306)

Section A.

① Choose the correct answer -!

① — ②

② — ③

③ — ④

④ — ⑤

⑤ — ⑥

⑥ — ⑦

⑦ — ⑧

⑧ — ⑨

⑨ — ⑩

⑩ — ⑪

Section B

Q. No. - 2 Stomata :- It is a natural opening of plants present in aerial parts mostly leaf surface

→ These are minute pores of elliptical shape surrounded by two specialised cells called guard cells.

→ Stomata pore size is changeable based on the cell turgidity.

→ Stomata are responsible for gaseous exchange and Transpiration in plants.

Components of a Stomata

① Subsidiary cells / Accessory cells.

⇒ These are cells which surrounded the guard cells.

② Guard cells ⇒ One Stomata there are two guard cells which are kidney shaped.

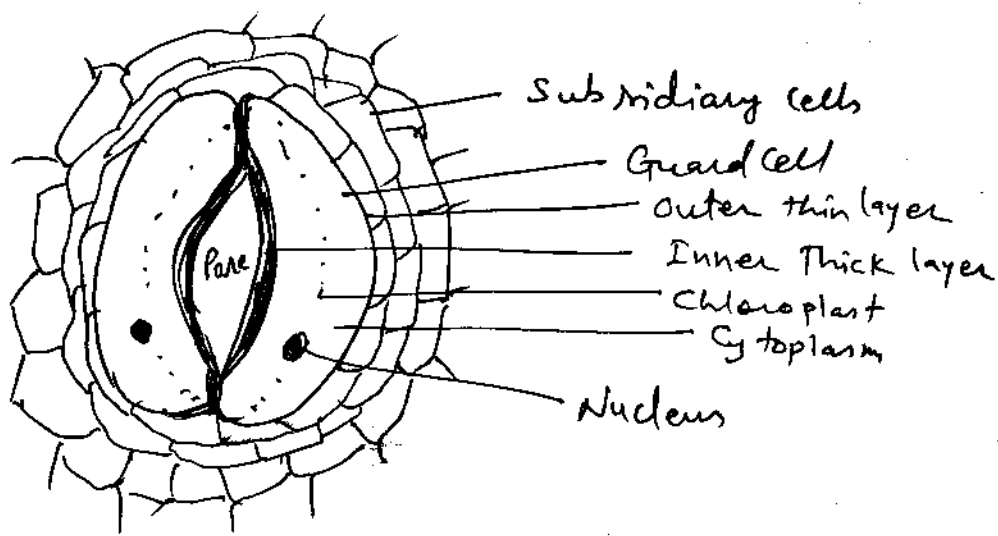
— Outer layer of guard cell is thin
Inner layer thick.

③ Pore ————— Between two guard cell one pore present.

~~Size~~ ⇒ — size depends on Turgidity of guard cells.

④ Chloroplast ⇒ many chloroplast present.

⑤ Nucleus ⇒ In each guard cell one nucleus present.



Stomata : opened Condition

Stomata :- Types.

- ① Apple Type \Rightarrow Stomata present on Lower surface of leaf
ex. \Rightarrow Apple, Mulberry.
- ② Oat type \Rightarrow stomata present on both surface of leaf
ex. \Rightarrow Oat, maize.
- ③ Potato type \Rightarrow much stomata present in Lower surface & few on upper surface of leaf.
ex. \Rightarrow Potato, tomato, Pea.
- ④ water-lily type \Rightarrow Stomata present on only upper surface of leaf
ex. \Rightarrow water lily,
- ⑤ Potamogeton type \Rightarrow stomata absent, ex. \Rightarrow Potamogeton.

Role in plants

- ① It help absorption of water, minerals etc.
- ② It support ascent of sap
- ③ helping diffusion through the cells
- ④ Important for osmotic regulation.
- ⑤ It helps in evaporating excess amount of water.
- ⑥ It plays a necessary role in translocation of food.

③ Chlorophyll → It is a green pigment.

→ many chlorophyll has been reported like chl. a, b, c, d, e, from various algae & higher plants.

→ There are more than one type chlorophyll present in algae, higher plants, Bacteria etc.

→ Chlorophyll is important for green colour of leaf and playing important role in photosynthesis.

→ Chlorophyll absorb light from blue 450 nm & Red 650-700 nm.

→ Bacterio-chlorophyll-b isolated from *Rhodospseudomonas* sps. but its structure is not yet known.

→ It is found in two forms 650 & 660.

→ Due to absorption of light these are known as chl-a-670, -673, chl-a-680-683, chl-a-695, 705 & P690, P700 etc.

→ all chlorophyll's structure is almost same.

→ Chlorophyll molecules are asymmetrical.

in which hydrophilic head - Porphyrin is made by four substituted Porphyrin rings. found around divalent Mg^{++} .

→ Molecular formula of chl-a - is $C_{55}H_{72}O_5N_4Mg$.

→ chl-b found in two forms $\left\{ \begin{array}{l} \text{Chl-b 640.} \\ \text{Chl-b 650.} \end{array} \right.$

Chlorophyll role in plants

- ① Providing green colour to the plants.
- ② Important for absorption of light
- ③ Supporting the process of photosynthesis
- ④ Important for food formation in plants.

④ Difference between "photosynthesis & Respiration."

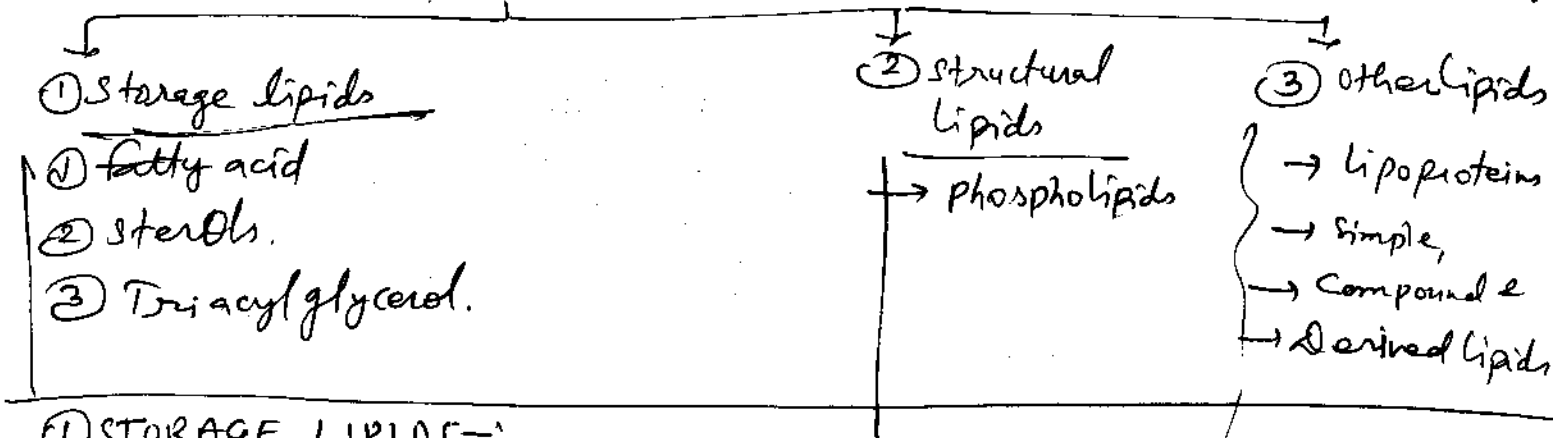
S.No.	Photosynthesis	Respiration.
①	Def. → Formation of Carbon containing compound by green plants in the presence of Sunlight, CO ₂ & water	① It is a breakdown process of food materials to release the energy for various life process
②	Chlorophyll, light, CO ₂ are necessary for photosynthesis	② These are not necessary for respiration
③	This is performed by the plants	③ It is performed by plants & animals both.
④	It is only in Day	④ It is in Day & Night Process
⑤	This is anabolic process	⑤ This is catabolic process
⑥	CO ₂ used & O ₂ released	⑥ O ₂ used & CO ₂ released
⑦	$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2 \uparrow$	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 673 \text{ K Cal. energy}$

⑤ Role of Gibberelins in plants : It is a plant hormone
their functions in plants are as-

- ① Seed germination \Rightarrow In cereals mostly, it is helpful for germination of seeds.
- ② Support of Bud growth \Rightarrow It is supporting initiation & growth of buds in plants.
- ③ Expansion of leaf \Rightarrow During plant development it ~~and~~ help to expand the leaf for providing much area of leaf for photosynthesis.
- ④ Flower Induction \Rightarrow It hormone also helpful for induction of flowering in the plants.
- ⑤ Increase length of Internode \Rightarrow a certain amount of this hormone is useful for increase of length of Internode in plants.
- ⑥ Parthenocarpy \Rightarrow It is useful for formation of seedless fruits without fertilization.
- ⑦ Pollen germination \Rightarrow After pollination this hormone supporting the germination of Pollen grain on stigma.
- ⑧ Prevention of ageing \Rightarrow Till a certain level it control ageing in plants.
- ⑨ Mobilization of food/Nutrients in plants it is important.

- ⑥ Lipids → These are molecules with hydrocarbon to make the structure of the cell.
- Lipids are natural molecules which includes sterols, oil, wax, vitamins etc.
 - Not soluble in water, hydrophobic in nature.
 - These are non polar, dissolved in organic solvent
 - These after oxidation release a large amount of energy useful for life systems.
 - fats, sterols, phospholipids are important components of cell membrane.
 - fatty acid having a long chain made by carboxylic acid.

Types



① STORAGE LIPIDS:-

- ① Fatty acid ⇒ These are main component of lipid, responsible for physical, metabolic process in body.
- In body these are released from triacylglycerol.
 - Essential fatty acids are linolic acid.
 - fatty acids having long chain of carbon.
- ② STEROL ⇒ Cholesterol is important in animal tissue
- It occur in free forms
 - It also includes lipoproteins
- ③ TRIACYL GLYCEROL ⇒ These are primary storage of fatty acid & are triesters.

② STRUCTURAL LIPIDS

→ these are complex lipids in membrane
→ Cellular membranes are important for transport of materials.

ex. → glycopospholipids.

③ Other lipids

→ ① lipo proteins → These are proteins bounded to fatty acids.

ex. → cholesterol.

Classification

① Simple lipids	② Compound lipids	③ Derived lipids
① Fats → Esters of fatty acids → glycerols.	→ Esters of fatty acids & alcohols contains another group also.	→ Compounds of hydrocarbons rings
② Wax → Esters of long chain fatty acids, alcohols.		→ long hydrocarbon chain chain present.

Role

- ① for Storage of energy
- ② source of energy
- ③ Shaping of cell
- ④ Thermal regulation
- ⑤ membrane transport
- ⑥ Transport of ions.

⑦ Kranz type leaf anatomy.

Characters ① Leaf of C_4 plants having a special leaf anatomy called Kranz leaf anatomy.

② C_4 plants are found in Tropical dry area.

③ C_4 plants showing xerophytic characters.

④ Sunken stomata ⑤ spines ⑥ reduced leaves present.

④ Dimorphic chloroplast found in C_4 plants

① In Mesophyll

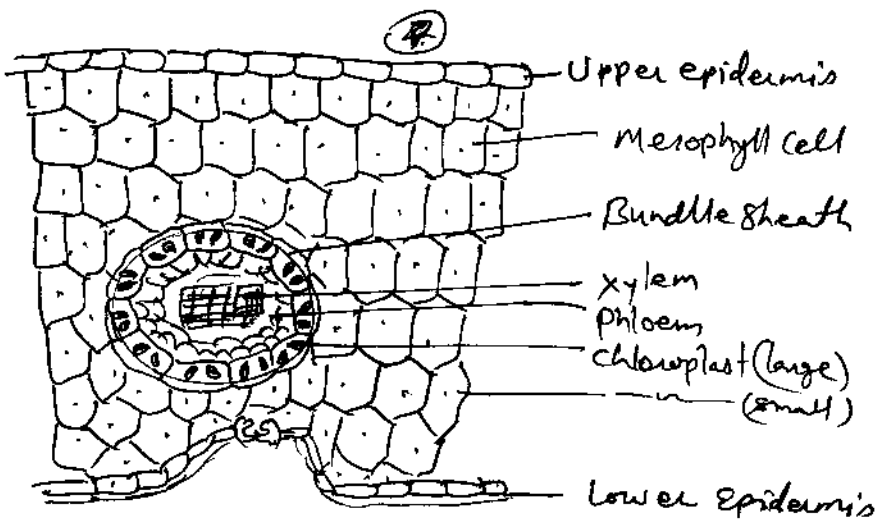
- Simple & small chloroplast present
- chloroplast - grana present
- PS-II present
- CO_2 Receptor → PEP
- PEP, carboxylic enzymes only in mesophyll.

② In Bundle sheath

- The chlorophyll are large in size
- chloroplast grana absent
- PS-II absent
- CO_2 Receptor RUBP

⑤ 1st Product → OAA.

⑥ Temperature ⇒ $30-45^\circ C$



Kranz anatomy in leaf of C_4 plant.

C_4 plant : Importance

- ① more photosynthetic activity (more than 2-3 times than by C_3 plant) found in C_4 plant
- ② Capable to grow in high temperature range
- ③ more CO_2 fixation capacity found in C_4 plants.

Section : (C)

(2) Macro Nutrients

- without nutrients plant does not complete their life successfully.
- It has clear physiological role in plants.
- Macronutrients are nutrients needed for plant growth & development.
- These are important for synthesis of organic molecules, basic body formation of the plant.
- Responsible for cell turgidity.
- Macronutrients are - C, H, O, N, P, K, Ca, Mg, etc.

Role in plants

- ① Plant body formation \Rightarrow C, H, O, N, P, K, Mg, ^{Ca} etc.
- ② Osmotic potential of cell \Rightarrow K
- ③ Movement of stomata \Rightarrow K
- ④ Cell permeability \Rightarrow Ca, K
- ⑤
- ① C, H, O \Rightarrow these are important for formation of framework of plant body.
 - Important for metabolic activity
 - Carbohydrate, protein, fat, cell wall etc. formation
 - Main component of organic compounds.
 - Plant absorb these from atmosphere

Nitrogen

- Essential constituents of protein, nucleic acid, many organic molecules
- Role in protein synthesis, chlorophyll synthesis.
- Part of Purin, Pyrimidines, NAD, NADP etc.

Phosphorus

- Synthesis of Nucleoprotein.
- Part of ATP, NAD, NADP.
- Important for photosynthesis, Respiration, fatty acid, protein syn.
- Fruit ripening
- Translocation of Carbohydrates.
- essential for plasma membrane

Potassium

- water balance
- Control on Toxic effect of Calcium.
- Control on enzymatic activity.
- Sugar, fatty acid, protein synthesis
- Support enzymatic hydrolysis.
- Activation of enzymes.
- Role in stomata opening & closing.

Magnesium

- Chlorophyll synthesis
- Carbohydrate metabolism
- Protein synthesis
- Support enzyme action.
- Phosphorus carrier
- Combination of subunits of Ribosomes.

Calcium

- Constituents of Cell wall
- Membrane permeability
- Initiation of Root hair formation
- Cell membrane & Lipid synthesis.

Sulfur

→ Amino acid synthesis

→ Vitamin - Biotin synthesis

→ Smell of onion, garlic are due to presence of sulfur compounds.

→ Cell division & for growth of plant

→ Supporting in fruiting.

⑨ Difference between Cyclic & Non-Cyclic photo-phosphorylation.

S.No.	Cyclic photo Phosphorylation	Non-cyclic photo-phosphorylation
①	Only photosystem-I present	① photosystem - PS-I + PS-II both present.
②	Electron moves in closed circle	② Electron moves in open circle
③	Reduced NADP Not found	③ Reduced NADP found
④	CO ₂ assimilation rate slow	④ CO ₂ assimilation rate fast
⑤	O ₂ Not released	⑤ O ₂ Released
⑥	mostly found in photosynthetic Bacteria	⑥ mostly found in green plants
⑦	The process is not inhibited by inhibitors (DCMU)	⑦ The process is inhibited by inhibitors.
⑧	Two ATP synthesized	⑧ One ATP synthesized
⑨	photooxidation of water absent	⑨ photooxidation of water present.

⑩ Role of Auxin in plants

- ① Apical dominance \Rightarrow Auxin playing a important role in apical dominance in newly developing plants. & also support production of new buds.
- ② formation of Roots \Rightarrow Indole Acetic Acid supporting development of roots in stem cutting
- ③ Stem elongation \Rightarrow Auxin is responsible for proper increasing of length in plant apical part.
- ④ Activation of Cambium \Rightarrow It promotes the activation of cambium in plants.
- ⑤ Control on abscission layer \Rightarrow It control on abscission layer formation in plants.
- ⑥ Seedless fruit formation \Rightarrow Parthenocarpic fruit can be developed by use of auxins.
- ⑦ Stimulator for Respiration it is important
- ⑧ growth movement Control \Rightarrow It is helping for various growth movement in plants
- ⑨ Callus formation \Rightarrow Callus is undifferentiated & un-organized mass of cells developed during of Tissue Culture. This hormone support the formation of Callus during the experiment
- ⑩ Weed Control \Rightarrow 2,4,D - weedicides kills the weeds
- ⑪ Breaking of dormancy of various plant parts

(11)

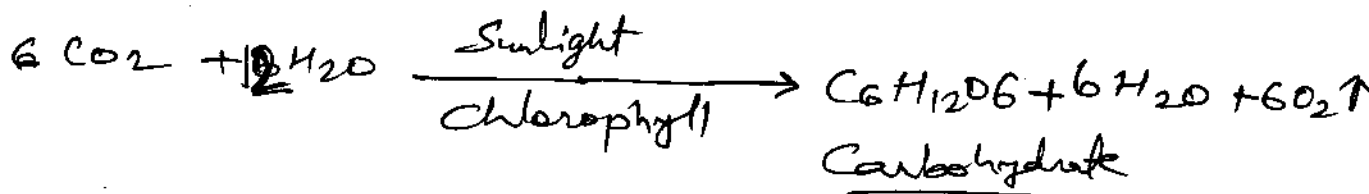
Photosynthesis

→ It is important physiological process in plant. and it is ability of green plants to change Solar / Radiation energy into chemical energy.

→ It is a process of synthesis of organic compounds by green plants.

→ According to Martin & Kammen (1963) Radiation energy converted into chemical energy in photosynthesis used by living beings.

Def. → formation of carbon containing compounds by green plants in the presence of sunlight, CO_2 & water.



Factors affecting photosynthesis

① External Factors

- ① Light
- ② CO_2
- ③ Temperature
- ④ Water
- ⑤ Oxygen
- ⑥ Minerals
- ⑦ Osmotic relationship of cell

② Internal Factors

- ① Chlorophyll
- ② Protoplasm
- ③ Plant age
- ④ Stored food materials
- ⑤ Plant hormones

EXTERNAL FACTORS

① LIGHT \Rightarrow Light affects the rate of photosynthesis in various ways.

① Light quality \Rightarrow 350 - 750 nm, not in UV/IR light maximum photosynthesis in Red light and in Blue light minimum.

\rightarrow Absorption of light depends on leaf size, shape, plant age etc.

\rightarrow 80% light absorbed by the plant & 20% Transmitted

\rightarrow Photosynthesis rate is also affected by duration of light.

② CO_2 \Rightarrow It is important raw materials for photosynthesis, and is absorbed by the green plants during of photosynthesis.

\rightarrow Terrestrial plants take CO_2 from atmosphere and aquatic plants absorb CO_2 by surface, from water in dissolved form of CO_2 .

\rightarrow Increasing of CO_2 concentration helpful for increasing of photosynthesis rate.

③ Temperature \Rightarrow A little affect of Temperature has been noticed in photosynthesis process.

\rightarrow Variation in temperature affect the Calvin cycle.

\rightarrow mostly photosynthesis rate increase in 5 - 35°C.

④ Water \Rightarrow It is indirectly affecting the photosynthesis. Basic need of plant life regulation including photosynthesis.

\rightarrow It is important to dissolve CO_2 & also important for osmotic regulation in plant.

⑤ Oxygen → It is byproduct of photosynthesis.

Warburg effect → Warburg 1920 demonstrated that release of O_2 and use of CO_2 reduced when O_2 present in high concentration in atmosphere. So, this is indirectly affecting the photosynthesis.

⑥ Minerals → Some mineral elements like Cu, which are component of photosynthetic enzymes or Mg, Fe, — components of formation of Chlorophyll are affecting the rate of photosynthesis.

⑦ Osmotic relations → It is also affect the rate of photosynthesis activity indirectly because it affects the availability of water.

INTERNAL FACTORS

① Chlorophyll → It is important for photosynthesis. It absorbs light during photosynthesis. So, presence of this pigment support photosynthesis.

② Protoplasm → Sap concentration, presence of enzymes etc are — playing important role in the process of photosynthesis.

③ Plant age → Young/mature plants performing much photosynthesis than a old plant.

④ Stored food materials → Proper utilization of food (photosynthetic products) are essential their deposition adversely affect the photosynthesis.

⑤ Plant Hormones → Some plant hormones like Gibberellins, Auxins etc. support the process of photosynthesis.