SREE SIDDAGANGA COLLEGE OF ARTS, SCIENCE and COMMERCE

B.H. ROAD, TUMKUR
(AFFILIATED TO TUMKUR UNIVERSITY)

DEPARTMENT OF BOTANY

LABORATORY MANUAL
III B.Sc, VI SEM
PRACTICAL PAPER-VII
(PLANT PHYSIOLOGY AND METABOLISM)

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IIIB.Sc VI SEMESTER CBCS

BOTANY Practical – VII SYLLABUS

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of rate of transpiration by Ganong's potometer.
3. Determination of stomatal index by Quickfix method.
4. Determination of Rate of Photosynthesis at different wave lengths of light.
6. Determination of Rate of Photosynthesis at different Concentrations of Co2 .
7. Separation of Photosynthetic pigments by paper chromatography . and measurement of *Rf* values

Demonstration experiments

1. Hydroponics
2. Study of any two mineral deficiency Symptoms.
3. Separation of photosynthetic pigments by solvent wash method.
4. Kuhne's experiment
5. Determination of Catalase activity.
6. Phototropism, geotropism and hydrotropism.

TUMKUR UNIVERSITY PRACTICAL EXAMINATION QUESTION PAPER

Time: 3 Hrs **BOTANY- paper –VII** **Max.marks: 50**

1**. Separate the photosynthetic pigments from the sample 'A' by paper chromatography and measure their Rf values.** **15**
(Requriments – 1 mark, Principle – 2 marks, Procedure – 5 marks, Conduction – 4 marks, Rf value- 3 marks).

2. Determine the Osmotic potential of the cell sap by Plasmolytic method / Stomatal index of the material 'B'. **10**
(Requirements – 1 mark, Principle- 1mark, Procedure- 3 marks, Conduction – 4 marks, Calculation & result – 1 mark.).

3. Comment on the experiments C, D and E **15**
(Identification – 1 mark, Principle -1mark, diagram – 1mark , comment – 2 marks.) .

4. Viva voce **5**
Viva-voce related to experiments given in the practical examination.

5. Class records **5**

Practical – VII **Experiment:1**

Determination of osmotic potential of plant cell sap by plasmolytic method.

AIM: - To measure osmotic pressure of the cell sap in the cell by Plasmolytic method.

REQUIREMENTS:-

One molar stock solution of sucrose, 10ml pipette, 6 test tubes,stand,6 cavity blocks with lid, 6 slides, cover slips, needle, microscope and Rheo plant.

PRINCIPLE:-

Diffusion of water across the semi permeable membrane is known as osmosis. Diffusion of water into the cell across plasma membrane is known as **"Endosmosis**".
Diffusion of water out of the cell across plasma membrane is known as "**Exosmosis".**
Shrinkage of protoplasm in the cell due to Exosmosis is known as "**Plasmolysis"**
Pressure developed in the soil solution when separated from the pure water by semipermiable membrane is called osmotic pressure. Cell sap of the cell expresses its own osmotic pressure in an osmotic system.

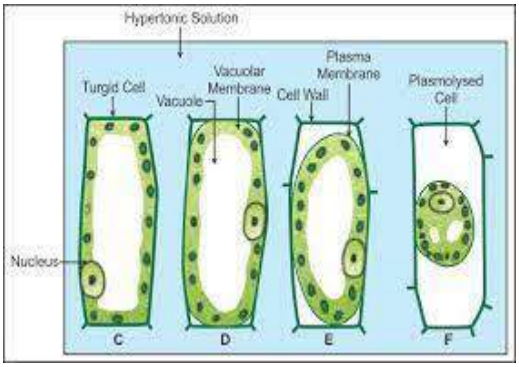
Osmotic pressure of cell sap can be determine by plasmolytic method, where osmotic of cell sap is equal to the osmotic pressure of the external solution in which 50%of the cell shows plasmolysis based on this principle. Osmotic pressure of the cell sap in the cell can be determined.

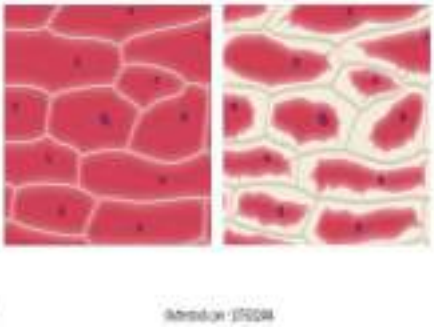
PROCEDURE:-

- Prepare 0.1 molar 0.2 molar, 0.3molar, 0.4 molar, 0.5 molar grades of sucrose from 1molar Stock solution of sucrose.
- Take 1ml of each grade of sucrose solution is separate cavity blocks.
- Place one piece of epidermal peel of Rheo leaf into each grade of solution in a cavity block. Then cover the cavity blocks with lid and leave it for 30 minutes.
- Mount the piece of epidermal peel on separated glass slides with their respective solution grades as mountant.
- Observe each slide under high power objective of microscope and count the number of cell showing plasmolysis. Record the readings.
  Find the concentration of the solution at which 50% of the cell shows plasmolysis.
  The osmotic pressure of the solution resulting plasmolysis in 50% of the cell is equal to osmotic pressure of the cell.

RESULT:-

Osmotic pressure of the cell sap of epidermal; cell in Rhoeo leaf is equal to----------





OBSERVATION AND CALCULATION:-

1. Preparation of 1M sucrose solution-Dissolve 34.2g of the sucrose in distilled water to make up the volume 100ml.

2.Preparation of 10ml of 0.1M,0.15M,025M,0.3M solutions from 1m stock solution.
Formula used for preparation of grades is

$$m_1v_1=m_2v_2$$

$$V_1=m_2v_2$$

where m_1= Molarity of stock solution
V_1= volume of stock solution
M_2 =Molarity of required [0.1ml]
V_2= volume of stock solution run down [10ml]

Table-1

Concentration required	Volume of stock solution	Volume of distilled water

Table-2 Number of cells observed under high power objective is 10 cells

Grade used	**No of cells plasmolysed**	**% of plasmolysis**

Calculation: -

1. Concentration of sucrose in which approximately 50% of cells are plasmolysed=
2. Osmotic pressure of ---------- sucrose=MRT
Where

M- Molar concentration of sucrose4 resulting 50% of plasmolysis
R- Gas constant [0.082atm/mol]

T- Temperature constant (room temp).

3. Osmotic pressure=MRT

= ---------X0.082X---------

RESULT =

Since osmotic pressure of 0.3m solution= osmotic pressure of cell sap

Osmotic pressure of the cell sap=----------

Experiment:2

Determination of stomatal index by Quickfix method.

AIM: - To study the Stomatal index of the leaf per unit area.

REQUIREMENTS:-

Vinca rosea leaves, Cellophane tape, Slide, Cover slip, Saffranin, Microscope.

PRINCIPLE:-

Stomata are minute pores present in the Epidermis of Leaves. Each stoma consists of an aperture bounded by 2 bean shaped Guard cells. The wall of the Guard cell lining the aperture is very much thicker than the rest of the sides. The Guard cells are surrounded by 2 or more epidermal cell called "Subsidiary cells.

$$I = \frac{S}{E+S} \times 100$$

Where 'I' is Stomatal index

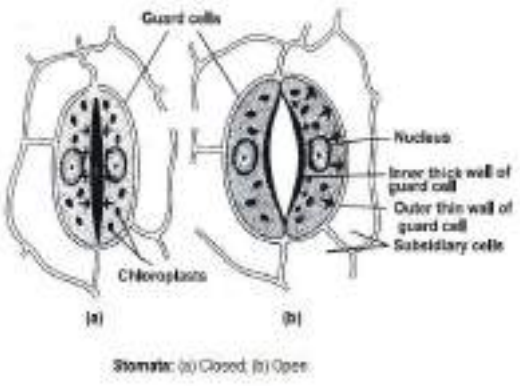
'S' is Number of Stomata per unit area

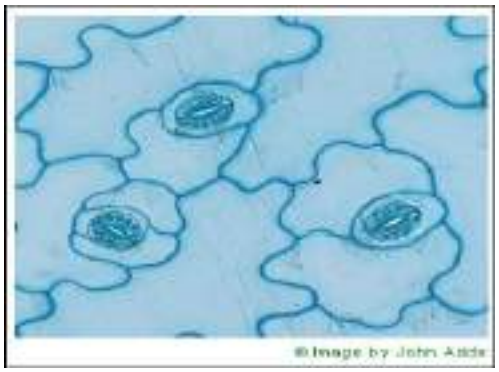
'E' is the number of epidermal cells per unit area.

PROCEDURE:-

- Select healthy Vinca rosea leaf , press piece of Cellophane tape firmly to the lower surface of the leaf(Lamina part)
- Remove cellophane tape from the leaf surface. Peel off Epidermis of leaf along with Cellophane tape.
- Mount the cellophane containing the epidermal peel on the glass slide.
- Observe the slide under low power and high power objective of the microscope and draw figure of the Stomatal aperture.
- Count the number of stomata and epidermal cell. Observed under low power and high power objective in the microscopic field. Record the findings.

RESULT: - Stomatal index is found to be ---------





TABULATION AND CALCULATION

Leaf used	**Number of stomata observed under high power objective**	**Total number of epidermal cell observed in the same microscopic field.**
Lower epidermis of Vinca rosea		

S I = ---------- X100
E+ S

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Experiment:3

Separation of photosynthetic pigments by solvent wash method.

AIM: Separation of photosynthetic pigments and measurement of Rf value (Ratio front).

REQUIREMENTS: - Pestle and mortar, Chromatographic chamber with split cork, Stand, Capillary tube, Air drier, Whatsman filter paper, Tecoma or Spinach leaves, Acetone, Petroleum ether.

PRINCIPLE;-

A pigment which takes part in Light reaction of photosynthesis includes Chlorophyll, Carotenoids; Xanthophyll.These in Solvent mixture shows different Solubility and different density rate and different rate of affinity with filter paper.

PROTOCOL

- Grind Tecoma leaves or Spinach leaves in Acetone into a homogenous mass by using Pestle and Mortor. Filter it to get the mixture in Acetone.
- Take strip of Whatmann's filter paper with a size of 2cmx 10cm. make its one end pointed.
- Load this paper strip with Acetone extract at the spot (1 cm from pointed end) using Capillary tube.
- Load the spot 30 to 40 times with subsequent drying with Air drier or blow till dark green colour appears in the spot.

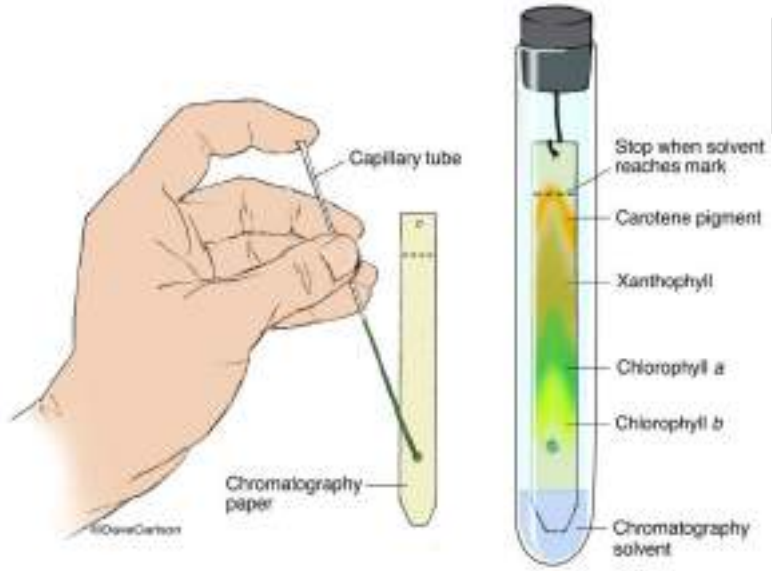
- Suspend this strip into chromatographic chamber containing Solvent mixture of Acetone and petroleum Ether in 1:9 ratio.
- Note that only pointed end of the paper should touches the Solvent mixture and not the loaded spot.
- Allow the set up for some time.

OBSERVATION:-

First yellow green colour develops (Chloropohyll-b), then bluish green colour (Chlorophyll-a), followed by Yellow (Xanthophyll) and then orange (Carotene) peaks appears at successive levels. Mark the boundaries of each loaded spot on the filter paper with Pencil, measure the distance travelled by each pigment from loaded spot and calculate ratio front of each pigment.

INFERENCE:-

The Solvent mixture moves on the filter paper. When mixture passes through the loaded spot, it carries different photosynthetic pigments from the spot to various levels on the paper depending on their solubility and density.



A. Applying spot of chlorophyll pigment B. Final chromatogram

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Demonstration experiments

1. **Ganong's photometer**
2. **Hydroponics**
3. **Mineral deficiency Symptoms (specimen / photocopy)**
4. **Rate of photosynthesis at different wavelengths of light.**
5. **Rate of photosynthesis at different Concentrations of Co2.**
6. **Kuhne's experiment**
7. **Phototropism**
8. **Geotropism**
9. **Hydrotropism**

Experiment:4

1. Ganong's Potometer

AIM:-To measure the rate of transpiration

REQUIREMENTS;-

Plant twig, Petroleum ether, water, Beaker, Ganong's potometer.

PRINCIPLE:-

The amount of water absorbed is almost equal to the amount of water transpired.

PROCEDURE:-

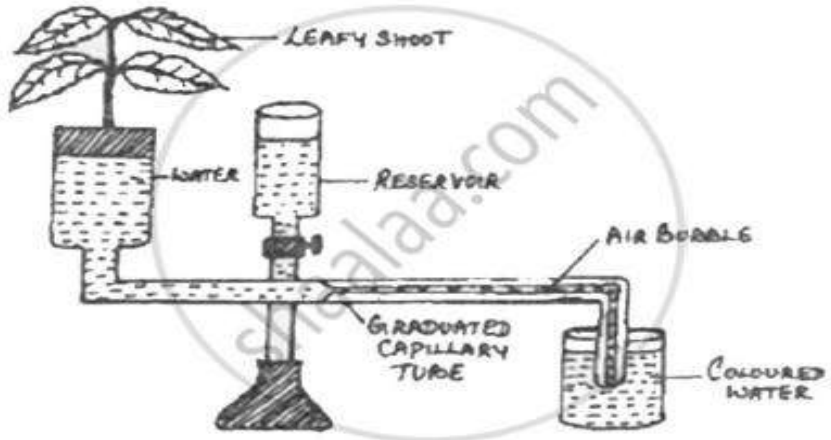
- Ganong's photometer consists of horizontal graduated capillary tube bent down on one side. The other end is widened and bent upwards to form a "Plant holder". Adjacent to plant holder is a reservoir connected to horizontal tube through a stop cock. The entire apparatus is supported on a wooden stand.
- Fill the apparatus with water using reservoir.
- Plant holder is fitted with one holed rubber cork. insert a plant twig cut under water though hole in the cork.
- Downwardly bent tube is dipped in a small beaker containing water.
- Introduce an air bubble to the capillary tube by lifting the end above water surface and touching it with a blotting paper and again dip it in water.
- Make all connections air tight by applying petroleum jelly. Leave the set up for some time and observe.

OBSERVATION:-

Movement of an Air bubble in the capillary tube is observed. As plant transpires it absorbs water through the cut end resulting in movement of air bubble.

INFERENCE:-The rate of transpiration **(**The Volume of water losed) in given time can be **calculated** by recoding **distance** travelled by an air bubble (t) **using the formula V= π r^2 h**

Where, **V**=Volume, **π** = 22/7, **r**= Radius of Capillary tube, **h**=Distance travelled by air bubble. Therefore, **Rate of transpiration=V/t.**



Experiment:5
2. AN EXPERIMENT TO DEMONSTRATE HYDROPONICS

AIM:- To study soil less growth of plant in a balanced nutrient solution.

REQUIREMENTS:-

Borosilicate bottle, seedling, two hold rubber cork, bent glass tube, balanced nutrient solution.

INTRODUCTION:-

Soil is required for terrestrial plants as a source of water and mineral nutrients, if the plant is provided with balanced nutrient and water, it can be grown even without the soil .Thus the growth of the plant in balanced nutrient solution is called '**Hydroponics'** or '**Soilless growth'**, it is also called '**Solution culture** 'as it involves the growth of plants by using nutrient solution.

PRINCIPLE:- All plants require certain inorganic mineral nutrients and water for their nutrition but not the soil.

PROCEDURE:-

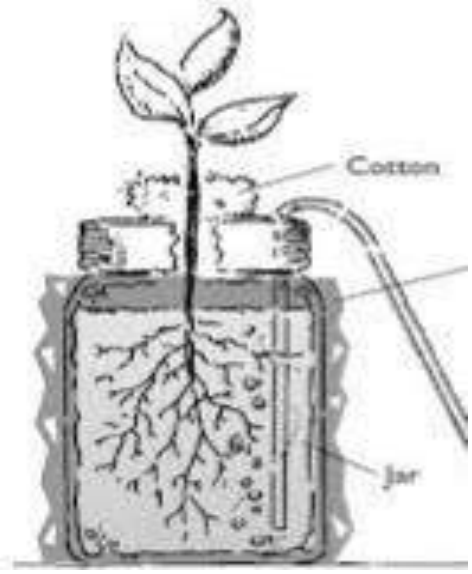
- Take water containing balance inorganic micro and macro nutrients in a borosilicate bottle.
- Close the mouth of bottle with a lid containing two holed rubber cork.
- Introduce health herbaceous seedling into the bottle through one hole of the cork.
- Introduce a bent glass tube into the bottle through the other hole in cork, to provide aeration of solution. Allow the set for some days.

INFERENCE:-

Seedling shows healthy growth and gives good crop yield as it gives when growth in soil.

SIGNIFICANCE OF HYDROPONICS:-

1. Hydroponics helps to cultivate ornamental plants and Vegetables in areas under extremely cold and dry environment where soil is unsuitable for cultivation.



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Experiment:6
3. STUDY OF ANY TWO MINERAL DEFICIENCY SYMPTOMS.

AIM:-

To study deficiency symptoms of minerals elements in plant nutrition.

INTRODUCTION:-

Plant requires various inorganic mineral elements for nutrition. Plant derived all their nutrients from soil based on the amount of requirement, Inorganic nutrients are classified into major and minor elements.

Some Inorganic nutrients are required by plants for healthy development in large amount, they are regarded as '**Major elements' or' Macro nutrients'. Ex:** Nitrogen, carbon, Oxygen, Phosphorus, Sulphur, Magnesium, Calcium, are required by Plants for their healthy development in small amount.

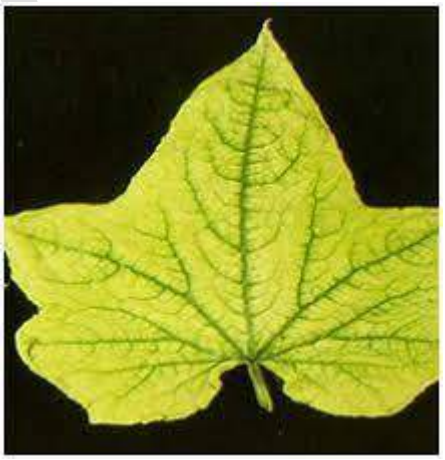
Some Inorganic nutrients are required by Plants for their healthy development in small amount. They are regarded as '**Minor elements**' or '**Micro nutrients'**. Ex: Boron, Molybdenum, Zinc, Copper, Chlorine, Cobalt, Silicon.

The deficiency of Inorganic nutrients in the plant nutrition results in expression of certain symptoms by plants. Among them the most common symptoms are **Chlorosis and Necrosis**.

1. CHLOROSIS: -

The **distruction of chlorophyll is called "Chlorosis" or "Yellowing**". It is a physiological manifestation that occurs due to deficiency of Major elements like Nitrogen, Magnesium and Iron.

- Deficiency of Nitrogen results in Chlorosis from apex towards base of leaf.
- Deficiency of Magnesium results in chlorisis from the apex and shows rolling.
- Deficiency of Iron results in Chlorosis of young leaves.



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Experiment:7

AN EXPERIMENT TO SHOW THE DEFEICIENCY SYMPTOM IN PLANTS

AIM:-

To study deficiency symptoms of minerals elements in plant nutrition.

INTRODUCTION:-

Plant requires various inorganic mineral elements for nutrition. Plant derived all their nutrients from soil based on the amount of requirement, Inorganic nutrients are classified into major and minor elements.

Some Inorganic nutrients are required by plants for healthy development in large amount, they are regarded as '**Major elements' or' Macro nutrients'. Ex:** Nitrogen, carbon, Oxygen, Phosphorus, Sulphur, Magnesium, Calcium, are required by Plants for their healthy development in small amount.

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The deficiency of Inorganic nutrients in the plant nutrition results in expression of certain symptoms by plants. Among them the most common symptoms are **Chlorosis and Necrosis**.

2**. NECROSIS**: -

Death of tissue in the leaf due to distruction of cells is called **"Necrosis**". Deficiency of Copper, Manganese, and Zinc causes Necrosis.

- Deficiency of Copper causes Necrosis at tips of young leaf in a plant.
- Deficiency of Manganese causes Necrosis at interveinal part of leaf in a plant.
- Deficiency of Zinc causes Necrosis of leaf in a plant. Necrotic tip will be larger in size.

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Experiment:8

4.DETERMINATION OF RATE OF PHOTOSYNTHESIS AT DIFFERENT WAVE LENGTHS OF LIGHT.

AIM:-To estimate the effect of different wavelength of light or quantity of light in the rate of photosynthesis.

REQUIREMENTS:-

Beaker, funnel, Test tube, Table Lamp, Water, Hydrilla plant, Red and Blue transparent paper.

INTRODUCTION:-

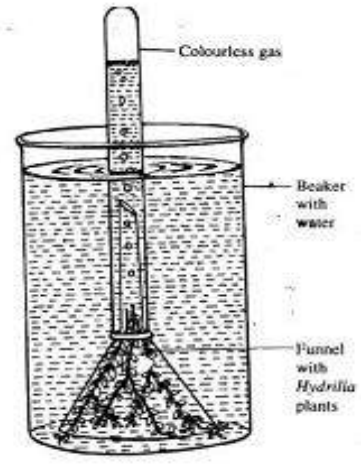
Chlorophyll absorbs different wave length of light at different rates. They absorb more Red lights at 662nm wave length than Blue light at 430nm wavelength. Hence the effect of different wavelength varies the rate of photosynthesis.

PROTOCOL:-

- Take few fresh twigs of Hydrilla; introduce the cut ends of Hydrilla plant into the stem of the funnel in a trough containing water.
- Invert the test tube filled with water over the stem of the Funnel. Keep the set up near the working table lamp of white light.
- Count the air bubbles emerging out of the Hydrilla stem in one min. Note the results.
- Cover the set up with Red transparent paper, count the number of air bubbles emerging out of the plant. Record the readings.
- Cover the set up with Blue transparent paper, count the number of air bubbles emerging out of the plant. Record the readings.

OBSERVATION:-

Sl. No	Quality of light	Air bubbles evolved per min
1	White	
2	Red	
3	Blue	



INFERENCE:-

The rate of photosynthesis is high in white light (Natural light), than monochromatic light (Red and Blue). It is more in Red light as compared to Blue light.

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Experiment:9

5.DETERMINATION OF RATE OF PHOTOSYNTHESIS AT DIFFERENT CONCENTRATIONS OF CO2.

AIM: To Study effect of carbon di oxide concentration on rate of photosynthesis .

REQUIREMENTS:-

Beaker, funnel, Test tube, Water, Hydrilla plant, Sodium bi carbonate ($NaHCO_3$).

INTRODUCTION:-

Photosynthesis is a colour sensitized Redox process during which non utilized form of Light energy will be converted into utilizable form of chemical energy, and as organic food by Green plants. During this process Carbon di oxide is utilized and Oxygen is liberated.

PRINCIPLE:-

Sodium bi carboinate ($NaHCO_3$) when dissolved in water results in release of CO_2 gas. Amount of Carbon di oxide released depends on amount of $NaHCO_3$ dissolved in water.

PROTOCOL:-

- Take few twigs of Hydrilla plant. Introduce the cut ends of Hydrilla into the funnel stem.
- Invert test tube filled with water over the stem of funnel.
- Keep the set up in Sun light. After few minutes oxygen bubbles emerge out from cut ends of Hydrilla twig, and collect at the closed end of test tube by downward displacement of water.
- Count the number of Gas bubbles coming out from cut end of the Hydrilla stem. Record it.
- Add 1gm of NaHCO3 into experimental set up. Count the number of Gas bubbles coming out from cut end of the Hydrilla stem. Record it.
- Repeat the experiment by adding 1.5gms, 2gms $NaHCO_3$ into each experimental set up respectively and count the number of gas bubbles evolved in each set.

OBSERVATION:-

SL.No.	**Amount of $NaHCO_3$ used as a source of CO_2**	**Number of gas bubbles evolved**

INFERENCE: - Increase in utilization of Sodium bi carbonate increases release of carbon di oxide, resulting in rate of Photosynthesis.

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Experiment:10

6. KUHNE'S EXPERIMENT

Aim: To demonstrate Fermentation

Requirements: -
Kuhne; s fermentation vessel, Sucrose solution (10%), Yeast, Cotton plug.

Introduction:-
Respiration is a catabolic process in which energy is released involving oxidation of organic compounds with molecular oxygen as an ultimate electron acceptor. In Aerobic respiration complete oxidation of respiratory substrate takes place in presence of Oxygen. In an Anaerobic respiration Partial oxidation of oxidation of respiratory substrates takes place to form carbonic acids like Ethyl alcohol, Acetic acid, Lactic acid along with carbonic acid and water in absence of Oxygen .

Principle:-

Anaerobic breakdown of Glucose to carbon di oxide and Ethanol is referred as 'Alcoholic fermentation'. It is carried by Yeast.

$C_6 H 12O6$ -------Yeast----------$2C_3 H C H_2 O H + 2 CO_2$ + Energy

Procedure:-

1. Kuhne's Fermentation Vessel consists of upright glass tube and a side tube with Bulb.
2. Fill the Kuhne's Vessel with 10% Sucrose solution and mix with small quantity of Yeast suspension.
3. Plug the mouth of the apparatus by cotton.
4. Leave it for 12to 18 hours.

Observation:-
Gas is collected in the top of the vertical limb by downward displacement of Solution and solution smells alcoholic on opening cotton plug.
When KOH pellet is put into the solution, it absorbs gas and solution raises to fill the vacuum.

Inference:-
This proves that collected gas is Carbon di oxide. Sugar is broken down into Alcohol and CO_2 by Yeast in absence of Oxgen . This process is referred as "Alcoholic fermentation".

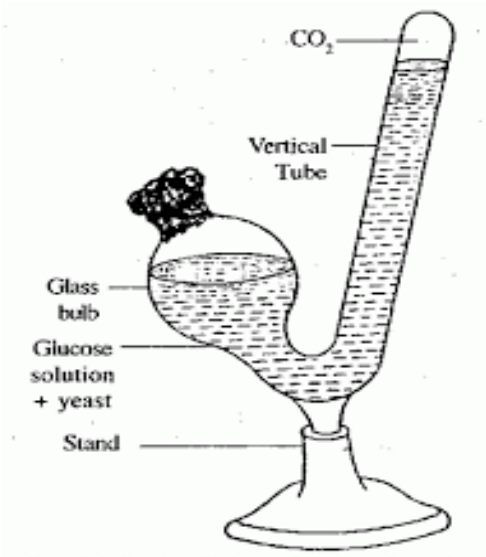

Fig. 5.3.5.c.4 : Kuhne's fermentation tube

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Experiment:11

7. Determination of Catalase activity.

Aim: To determine the Catalase activity

Introduction:-

Enzymes are proteins that act as biological catalysts. (They help chemical reactions proceed more easily in the bodies of an organism) Enzymes are thermo-labile organic catalysts which are very much sensitive to heat and pH.

Principle: -

Hydrogen peroxide is produced naturally in organisms, but is very harmful. **Catalase** and other enzymes help to break **hydrogen peroxide into water and oxygen gas**. (The bubbling observed when we pour hydrogen peroxide on a cut, is the oxygen gas produced from catalase activity). All Enzymes including catalase, have specific structures that help them to bind with their substrate and complete the chemical reaction. Changes in temperature and other environmental conditions can alter the structure of a protein .If an enzyme changes its structure, it may no longer work.

In this is an experiment using Raw potatoes as the tissue samples Catalase activity, and the temperature at which catalase denatures and is no longer active, is estimated based on the amount of oxygen bubbles produced as follows:-

Requirements:-

2-3 large raw potatoes,1 bottle of hydrogen peroxide,5-small glass dishes, 5 test tubes, knife and cutting boards, A hotplate or stove, Pot of water, Thermometer spoon or fork.

Procedure :-

1. Wash and Cut potatoes into very small ¼ inch pieces. Place potatoes into the pot containing cold water.
2. Place thermometer into the water with the potatoes. Record the temperature.

- With a spoon remove three pieces of potato and place it into a small dish. Write the temperature on the dish, at which you removed the potato pieces. Do not seal the dish.
- Place the pot of water containing potatoes on the stove and turn on low. After the temperature has risen another 5 degrees, remove another three pieces of potato and place into a dish. Record the temperature on the dish and in notes .
- Continue heating and removing pieces of potato every 5 degrees. (Scientifically, you should do this in degrees Celsius, but if you only have a Fahrenheit thermometer. With a Fahrenheit thermometer, you may want to remove potatoes only every 10 or so degrees. Whichever you do, be sure to record every temperature as accurately as possible).
- Stop removing potatoes when they are completely soft, when the water boils, or when the potato is gone, whichever occurs first.

3. Set up test tubes with equal amounts of hydrogen peroxide in each. (fill about 1/3 full). Record the measurement of hydrogen peroxide used. Place dishes of potatoes behind test tubes in the order they were removed from the pot of water.
4. Carefully add first potato pieces removed into the first test tube of hydrogen peroxide. Observe the bubbling and record the amount.
5. If there are lots of bubbles, use ++++, if there are some, use +++, if there are a few, use ++, just a couple, use +.If there are no bubbles, record a 0 for the sample.
6. Continue testing potato pieces in fresh hydrogen peroxide until you have tested them all. (Be sure to wash any utensils that touch another sample before using them again).
7. Create a line graph of the bubbling activity for the potatoes
8. Draw a conclusion about the temperature at which catalase is denatured based on your graph. This enzyme catalyses the decomposition of H_2O_2 into H_2 ,O_2 and water.

Observations: - Evolution of O_2 is noted, till No **evolution of O_2**.

Inference: - Presence of Catalase activity. Absence of enzyme activity as the tissue is dead.

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Experiment:11

8. AN EXPERIMENT TO SHOW PHOTOTROPISM

AIM: - To show the Positive Phototropism of Stem.

REQUIREMENT:-

Bending movement of the Plant organ due to unilateral application of stimulus of light is called "**Phototropism"**. If the Plant organ bends towards the stimulus of light, it is said to be 'Positively phototropic', if the Plant organ bends away from the stimulus of Light, it is called "Negatively Phototropic".

PRINCIPLE:-

Unequal distribution of Auxin in the stem of the plants or root tip of the Plants causes differential growth.

PROTOCOL:-

Keep the Seedling pot inside the phototropic chamber. Phototropic chamber is a light proof box with a small window on one side of the wall to allow light rays.

OBSERVATION:-

Stem tip bend towards the window, i.e., towards, the source of light.

INFERENCE:-

This shows positive phototropic nature of stem. Unilateral application of stimulus of light to the stem tip results in unequal distribution of Auxines, where more Auxin concentration towards the shade side induces greater stem elongation. As a result of this Plant bend towards the light side. i.e. Stem tip bends towards the window due to stimulus of light.

Experiment:13

9. AN EXPERIMENT TO SHOW GEOTROPISM

AIM:- To demonstrate the Negative geotropic movement (Elimination of Trophic movements in plants).

REQUIREMENTS: - Clinostat, Seedlings.

PRINCIPLE: -

The bending movement of a Plant organ due to unilateral application of Gravitational stimulus is called "**Geotropism"**, If the Plant organ bends towards the stimulus of Gravity it is called "**Positive geotropism**". If the Plant organ bends away from the stimulus of gravity, it is called "**Negative Geotropism**". Generally Root is positively geotropic and Stem is negatively geotropic in nature. If the plant organ is supplied with diffused application of Gravitational stimulus, it never shows any type of Tropic movements.

It can be demonstrated as follows:-

A) PROCEDURE: - (Control set)

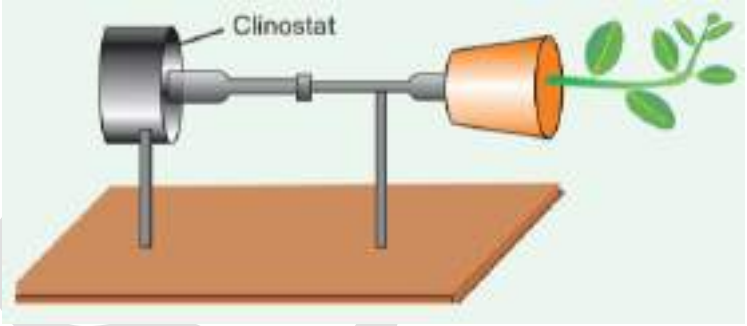
- Clinostat consists of Stopclock with an axis in which metallic pot is fixed. Place a seedling in the pot of the Clinostat.
- Keep the Clock horizontally (Clock not in working condition).Allow the set up for some days.
- The stem tip bends upwards and grows away from the stimulus of gravity towards source of sunlight.

INFERENCE: - This shows Negative geotropism of stem.

B) PROCEDURE: - (Experimental set)

- Clinostat consists of Stopclock with an axis in which metallic pot is fixed. Place a seedling in the pot of the Clinostat.
- Keep the Clock in working condition; allow the set up for some days.
- When the clock is at working condition, the Pot along with seedling rotates one round per hour.
- During rotation, the tem tip instead of bending up wards grows horizontally.

INFERENCE: - This shows Negative geotropism of stem.



Experiment:14

10. AN EXPERIMENT TO DEMONSTRATE HYDROTROPISM

AIM: - To show Hydrotropic movement of roots.

REQUIREMENTS:-

Shallow box with perforation at the bottom, Saw dust, Water soaked seed.

INTRODUCTION:-

Bending movement of the root due to unilateral application of stimulus of water is called "**Hydrotropism**". Roots are sensitive to amount of moisture and show tendency to grow

towards source of moisture and are said to be **positively hydrotropic** .Unequal distribution of Auxines at the root tip due to unilateral stimulus of water causes bending movement.

PRINCIPLE:-

The root grows towards the stimulus of water in the soil. Hydrotropic force is greater than the geotropic force.

PROTOCOL:-

- Porous Clay funnel (perforated Porcelain funnel), covered around with a filter paper, is placed on wide mouthed bottle filled with water.
- Porous funnel is filled with dry saw dust and water soaked seeds are arranged near the pores.
- Frequently sprinkle water to help seed germination.

OBSERVATION:-

As seeds germinate, instead of growing vertically down wards in response to force of gravity, move out through the pores towards moist filter paper, and grow downward along the side of the paper into the bottle.

INFERENCE:-

Roots thus show movements towards moisture. ie Positive Hydrotropism of root and Hydrotropic force is greater than geotropic force.

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