1)   Introduction to Equipment Used in Crop Physiology:

All Equipment which are present in SSL. Laboratory Visit and Demonstration about all equipment.

2)   Preparation of Various Solutions:

Solutions:

A solution is a special type of homogeneous mixture composed of two or more substances. In such a mixture, a solute is a substance dissolved in another substance, known as a solvent.

- ➢ Standard Solution
- ➢ Percent Solution
- ➢ PPM Solution
- ➢ Molar Solution
- ➢ Molal Solution
- ➢ Stock Solution
- ➢ Normal Solution

Standard Solution:

Solution whose concentration is known. Known quantity of solvent is dissolved in known quantity of solute.

Why We Prepare Standard?

It is prepared using a standard substance, such as a primary standard. Standard solutions are used to determine the concentration of other substances, Such as solution in titration.

Percent Solution:

Percent solution may be defined as the gram of solute dissolved in 100ml of solution.

For Example:

Prepare 5% solution of 'K' from K_2SO_4 .

Solution:

Atomic weight = K_2SO_4

$$= (39 \times 2) + 32 + (16 \times 4)$$

$$= 78 + 32 + 64$$

$$= 174g$$

78g of K is present = 174g of K_2SO_4

1g of K is present = 174g /78g of K_2SO_4

5g of K will be present = 174g/78g x5g of K_2SO_4 = 11.15g of K_2SO_4

K_2SO_4 required for 100ml of 5% K solution = 11.15g

However, we take 11.15 g of K_2SO_4 and dissolved in 100ml of water. Then the 5% of 'K' solution will be prepared.

ppm Solution:

"ppm solution may be defined as the milli gram of solute dissolved in per liter of solution''.

For Example:

Prepare 5 ppm solution of Na from NaCl.

Solution:

Atomic weight = NaCl

$$= 23 + 35.5$$

$$= 58.5g$$

23mg of Na is present = 58.5mg of NaCl

1mg of Na is present = 58.5mg/23mg of NaCl

5mg of Na is present = 58.5mg/23mg x 5mg of NaCl

$$= 12.7mg \text{ of NaCl}$$

However, we will take 12.7mg of NaCl in 1-liter volumetric flask and make 1 liter of solution by adding distilled water up to the mark. Then the solution will be prepared.

Molar Solution:

It is based on Molarity.it is denoted by **'' M''**.
It is defined as Number of moles of solute dissolved per liter of solution.

Mole:

When atomic weight of an atom, molecular weight of a molecule, or a formula unit weight is taken in gram is call a Mole.

For Example:

Prepare 0.5 M solution of Zn from $ZnSO_4$.

Solution:

Atomic weight = $ZnSO_4$

$$= 65 + 32 + (16 \times 4)$$

$$= 65 + 32 + 64$$

$$= 161g$$

1M of $ZnSO_4$ contain = 65g

0.5 M of $ZnSO_4$ contain = 65 x 0.5 = 32.5g

65g of Zn is present = 161g of $ZnSO_4$

1g of Zn is present = 161g/65g of $ZnSO_4$

32.5g of $ZnSO_{4s}$ = 161g/65g x32.5g

$\qquad$ = 80.5g of $ZnSO_4$.

$\qquad$ However, we will take 80.5g of $ZnSO_4$ in volumetric flask and make the solution up to the mark for 1000ml of Zn solution by adding distilled water. Then the solution will be prepared.

Molal Solution:

$\qquad$ It is denoted by **''m''**. It is based on molality.
$\qquad$ It is defined as the number of moles of solute dissolved per liter of solvent.

The final volume of molal solution may exceed to 1 liter.

For Example:

$\qquad$ Prepare 0.3 molal solution of Nitric Acid.

The specific gravity is 1.8 and purity % is 90.

Solution:

$\qquad$ Molecular weight = HNO_3

$\qquad\qquad\qquad$ = 1 + 14 + (16 x 3)

$\qquad\qquad\qquad$ = 1 + 14 + 48

$\qquad\qquad\qquad$ = 63g

1m HNO_3 contain = 63g

0.3m of HNO_3 will be contain = 63 x 0.3

$\qquad\qquad\qquad$ = 18.9g

Now, we will convert grams into m/s

m/s of HNO_3 required = 1.89/1.8 x 0.90 = 11.67m/s of HNO3

$\qquad$ However, we take 11.67m/l of HNO_3 in a beaker and also take 1 liter of distilled water in a flask.

Normal Solution:

$\qquad$ It is denoted by ''N''. and it is based on Normality.

Normality:

It is defined as the gram eqvilent of solute dissolved per litter of solution.

Gram eqvilent weight = Atomic, Molecular, Formula wt./Valency

Valency: Ability of any molecules compound to combine or replace H^+.

For Example:

Prepare of 0.2N solution of Na from Na_2So_4.

Solution:

Formula weight of Na_2SO_4 = (23 x 2) + (32) + (16 x 4)

$$= 46 + 32 + 64$$

$$= 142g$$

Gram eqvilent weight of Na = 42/2 = 23g

1N of Na from Na_2So_4 contain = 23g

0.2N of Na from Na_2SO_4 contain = 23 x 0.2

$$= 4.6$$

46g of Na present in = 142g of Na_2SO_4

1g of Na will be present in = 142/46 of Na_2SO_4

4.6g of Na will be present in = 142/46 x 4.6

$$= 14.2g \text{ of } Na_2SO_4$$

We will take 14.2g of Na_2SO_4 in flask and make the volume of 1 liter by adding distilled water.

Stock Solution:

A stock solution is a concentrated standard solution that will be diluted to some lower concertation for actual use.

Why we make a stock solution?

In order to make series of solution for the experiment.

For Example:

Prepare the working solution of 10ppm ,15ppm ,25ppm, from the stock solution of 1000ppm. The volume of working solution is 250ml.

Solution:

$$C_1V_1 = C_2V_2$$

$$1000 \times v_1 = 10 \times 250/1000$$

$$V_1 = 2.5 \text{ ml}$$

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$$V_1 = 15 \times 250/1000$$

$$= 3.5\text{ml}$$

$$V_1 = 25 \times 250/1000$$

$$= 6.25\text{ml}$$

However, to make these solutions we take 2.5ml ,3.5 ml and 6.25ml of 1000ml stock solution. To make stock solution of NaCl we add 9.25mg of NaCl is added in 1ml Volumetric flask.

3)   Measurement of Soil Water (Moisture) Contents:

Apparatus:

- ➢ Aluminium Moisture Box
- ➢ Oven
- ➢ Desiccator

Procedure:

- ➢ Take 100g of soil sample in Aluminium Moisture Box and keep in the oven after moving the lid of box.
- ➢ The sample is kept at 105^0C till it attains a constant weight. It may take 24-36 hours.
- ➢ Cool the sample first in the switch off oven and then in Desiccator.
- ➢ Take the weight of cold Moisture Box. The lost in weight is equal to moisture contain in 100g soil sample.

$$\textbf{Moisture \% = } \underline{\textbf{Fresh Weight – Oven Dry Weight}} \times \textbf{100}$$
$$\textbf{Oven Dry Weight}$$

4)   Seed Germination and Seedling Growth:

Perform seed germination experiments in Laboratory, Wire House or Field Area.

5)   Nutrient Diagnosis in Crop Plant:

Deficiency Symptoms:

Macronutrients:

- ✓ Nitrogen
- ✓ Phosphorus

- ✓ Potassium

Nitrogen:
- ➤ Poor growth of vegetative shoots.
- ➤ Chlorosis with yellow green leaves.
- ➤ Poor crop.
- ➤ Early ripening.

Phosphorus:
- ➤ Stunted growth of shoots
- ➤ Retarded growth of roots
- ➤ Leaves tend to become small, brittle and brownish green
- ➤ Reduced fruiting

Potassium:
- ➤ Reduced production of sugar
- ➤ Small leaves
- ➤ Premature death of plants/leaves
- ➤ Stunted plants

<u>Micronutrients:</u>
- ✓ Calcium
- ✓ Magnesium
- ✓ Sulphur
- ✓ Zinc
- ✓ Boron
- ✓ Copper
- ✓ Manganese
- ✓ Iron

Calcium:
- ➤ Chlorosis of leaves
- ➤ Death of leaf tips and rolling of leaves
- ➤ Young leaves distorted
- ➤ Growing points die out.

Magnesium:
- ➤ Chlorosis of leaves
- ➤ Premature leaf fall
- ➤ Yellowing of older leaves
- ➤ Growth is ceased

Sulphur:
- ➤ Yellowing of leaves
- ➤ Reduced flowering
- ➤ Poor root system

Zinc:

- Mottling and necrosis
- Drying of growing tips
- Curling of leaves

Boron:

- Splitting of bark
- Exudation of gum
- Growth stunted and stem brittle

Copper:

- Breakdown of older leaves
- Stimulation of gum exudation
- Yellowing of vein

Manganese:

- Chlorosis of leaves
- Mottling of leaves
- Chlorosis of margins
- Older leaves get wilted and scorched in Sugar Cane

Iron:

- Yellowish green younger leaves
- Plants short
- Leaves chlorotic

Molybdenum:

- Leaves and veins become pale
- Brown spots appear between veins
- Tissue browns and dies from the edge of leaf