

## Exercise No 1:-

### Raising of Plants in Different growth media.

#### What does growing media means?

Growing media are materials that plants grow in. They are designed to support plant growth and can either be a solid or liquid. Different components are blended to create home made and commercial growing media. Different types of growing media are used to cultivate various plants. They are also known as grown media, culture media or substrate.

Growing media have three major functions:-

- 1 Physically support plant growth.
- 2 Allow for maximum root growth.
- 3 Supply roots with necessities such as  $H_2O$ , air and nutrients.

A growing medium can be defined as a substance through which plant roots grow and extract  $H_2O$  and nutrient. Selecting a good growing medium is fundamental to good nursery management and is the foundation of a healthy root system. Growing medium for use in container nurseries is available in 2 basic forms : soil based and organic based. Compared with soil based media that has field soil as a major component, organic based media (a base of OM that may be compost, peat, coconut

(<sup>2</sup>) Coir, other organic materials, mixed with inorganic ingredients.) Promote better root development. In Temperate areas nurseries can choose from a wide range of commercial products for their growing media, including peat moss, vermiculture and perlite and pre-mixed blends of these ingredients. Most nurseries in Tropics however don't have easy and affordable access to these materials and even nurseries in Temperate areas are seeking to replace some of these ingredients with more local and sustainable materials. In the Tropics growers often create their own media using locally available ingredients. A favorable growing medium consists of two or more ingredients. Growers must be familiar with the positive and negative characteristics of the various ingredients and how they will affect plant growth when creating a suitable growing medium or even when purchasing a commercial one.

### Types of Growing Media :-

1 **Soil**:- is the most common growing medium for plants. Soil is a mixture of solid particles, water and air. Minerals are inorganic. Minerals particles in soil are formed by the break up of much larger rocks by physical, chemical and biological weathering. Organic material is made when dead organism such as plants and animals decompose and decay. The space between soil particles is filled with H<sub>2</sub>O which have numbers

of solutes dissolved in it. There are also pockets of air trapped in the H<sub>2</sub>O.

2 **Compost**:- is a growing medium used in greenhouses for:-  
- Germinating seeds - growing plants. It is also used for indoor plants. There are many different types of compost. Sometimes the term compost used to describe the product of organic waste when it rots & decays. The term compost to mean only the product of organic waste decay.

3 **Water (Hydroponic cultivation)**:- Some plants are grown in H<sub>2</sub>O rather than soil or compost, but it is not common at the moment. Advantages :- less space, shorter growing time, higher yields. Disadvantages :- setup costs are high, diseases and pests can easily affect each plant and plants react quicker to changes in the environment.

#### 4 Other Types of materials:-

##### A. Peat & Peat-like Materials

Peatmoss is formed by the accumulation of plant materials in poorly drained areas. The type of plant material and degree of decomposition largely determine its value for use in a growing medium. Although the composition of different peat deposits vary widely, four distinct categories may be identified.

1 **Hypnaceous moss**:- This type of peat consists of the partially decomposed remains of hypnum, Polytrichum and other mosses of the Hyperbaceae family. Although it decomposes more rapidly than some other peat types, it is suitable for media use. Many of peat deposits in the North US are hypnaceous.

## ii Reed & sedge :-

are peats derived from the moderately decomposed remains of bushes, coarse grasses, sedges, reeds & similar plants. These fine textured materials are generally less acid & contain relatively few fibrous particles. The rapid rate of decomposition, fine particle size and insufficient fiber content make reed & sedge peats unsatisfactory for media use.

## iii Humus or Muck :-

consist of decomposed debris of finely divided plant materials of unknown origin. Humus often contains large quantities of silt & clay particles, and when mixed with soil does not improve drainage or aeration. Due to its rapid rate of decomposition and particle size, humus is considered to be undesirable for growing media use.

## iv Sphagnum moss :-

is the dehydrated remains of acid bog plants from the genus *Sphagnum*. It is light in weight and has the ability to absorb 10 - 20 times its weight in H<sub>2</sub>O. Sphagnum moss contains specific fungistatic substances which accounts for its ability to inhibit damping off of seedlings. Sphagnum moss is perhaps the most desirable form of OM for the preparation of growing media. Drainage & aeration are improved in heavier soils while moisture & nutrient retention are increased in lighter soils.

## B. Wood Residues :-

constitute a significant source of soilless growing media. These materials are generally by-products of the lumber industry and

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be readily available in large quantities. Nitrogen depletion by soil microorganisms, during the decomposition process, is one of the primary problems associated with these materials. However, supplemental applications of N to the growing media can make most wood residues valuable amendments.

i) **Leaf Mold:-** maple, oak and sycamore are among the principle leaf types suitable for the preparation of leaf mold. layers of leaves and soil are composted together with small amounts of nitrogenous compound for approximately 12-18 months. The use of leaf mold can effectively improve the aeration, drainage and H<sub>2</sub>O holding properties of a growing media. Although these materials are readily available at low cost, leaf mold is not extensively used in container production.

ii) **Sawdust:-** The species of tree from which sawdust is derived largely determines its quality and value for use in a growing media. Several sawdusts, such as walnut & non-composted redwood, are known to have direct phototoxic effects. However C:N of sawdust is such that it is not readily decomposed.

iii) **Barks:-** are primarily a byproduct of the pulp, paper and plywood industries. Suitable particle size is obtained by hammer milling and screening. This produces a material which is suitable for use in container media. Physical properties obtained from tree barks are similar to those of sphagnum moss.

C- **Bagasse** :- is a waste by product of the sugar industry. It may be shredded and/or composted to produce a material which can increase the aeration and drainage properties of container media. Because of its high sugar content, rapid microbial activity results after the incorporation of bagasse into a media. This decrease the durability & longevity of bagasse and influences N levels. Bagasse is readily available at low cost, its use is limited.

D- **Rice Hulls** :- are a byproduct of the rice milling industry. Although they are extremely light in weight, rice hulls are very effective at improving drainage. The particle size and resistance to decomposition of rice hulls and sawdust are very similar.

E- **Sand** :- A basic component of soil, ranges in particle size from 0.05mm - 2.0mm in diameter. Fine sands do little to improve the physical properties of a growing media and may result in reduced drainage and aeration. Medium and coarse sand particles are those which provide optimum adjustments in media texture. Sand is valuable amendment for both potting and propagation media. It is used for growing plants in experiments like nutrients, biofertilizers and microbiological studies. Sometime sand needs to be sterilized with acid & then autoclave before using in such type of experiments.

F- **perlite** :- is a siliceous mineral of volcanic origin. The grades used in container media are 1/8" crushed

and then heated until the vaporization of combined H<sub>2</sub>O expands it to a light powdery substance. Lightness and uniformity make Perlite very useful for increasing aeration and drainage.

Perlite is very dusty when dry and has a tendency to float to the top of a container during irrigation. It contains potentially toxic levels of Fluorine. Although costs are moderate, Perlite is an effective amendment for growing media.

**G.** **Vermiculite**:- is a micaceous mineral produced by heating to approximately 745°C. The expanded, plate-like particles which are formed have a very high H<sub>2</sub>O holding capacity and aid in aeration and drainage. Have ability to supply Potash & Magnesium. Less durable than sand & Perlite. Chemical & physical properties are desirable.

**H-** **Calcined Clays**:- are formed by heating montmorillonitic clay minerals to approximately 690°C. The pottery like particles formed are 6 times as heavy as Perlite. Have high cation exchange as well as H<sub>2</sub>O holding capacity. This material is durable & useful amendment.

These are utilized to increase the number of large pores, decrease H<sub>2</sub>O holding capacity and improve drainage & aeration. Pea gravel, Pumice, cinders are also suitable for this use.

**I-** **Expanded Polystyrene**:- Polystyrene flakes, a byproduct of Polystyrene processing, resistant to decomposition, increase aeration and drainage and

decrease bulk density. They may be broken down by High Temp & by certain chemical disinfecting agents.

**J. Urea Formaldehydes:-** This material is prepared by mixing air with liquid resin and allowing to cool. Urea Formaldehyde foams have a greater H<sub>2</sub>O holding capacity than polystyrene but are similar in their influence on germination and drainage. Raw materials are very easily transported and very effective.

## Preparing Soilless growing media:-

Although amendment combinations may vary, basic objectives in the preparation of a growing media are alike.

- 1 Porous and well drained, Retentive of sufficient moisture to meet the H<sub>2</sub>O requirement of plants b/w irrigations.
- 2 relatively low in soluble salts, but with an adequate exchange capacity to retain and supply element necessary for plant growth.
- 3 Standardized and uniform with each batch to permit the use of standardized fertilization and irrigation programs for each successive crop.
- 4 Free from harmful soil pests, Pathogenic organisms, soil insects, nematodes and weed seeds.
- 5 Biologically and chemically stable.

Factors that determine the cost of a growing medium include - Transportation, labour, equipment, materials

Volume / volume Ratio	Components
2 : 1	Peat , Perlite <sup>1</sup>
2 : 1 : 1	Peat, Perlite, vermiculite
2 : 1	Peat , sand
3 : 1	Peat , sand
3 : 1 : 1	Peat, Perlite, vermiculite
2 : 1 : 1	Peat , Bark , sand
2 : 1 : 1	Peat , Bark , Perlite
3 : 1 : 1	Peat , Bark , sand

<sup>1</sup> Foam beads may be used in place of Perlite

and handling. Recommended growing medium are given in Table.

## Exercise No 2:-

### Soil Less culture :-

In which The Plants are grown without soil. The nutrients, water, aeration and anchorage must be given to plants.

The most Popular Soil less culture are:-

1 Hydroponic

2 Aeroponic

1

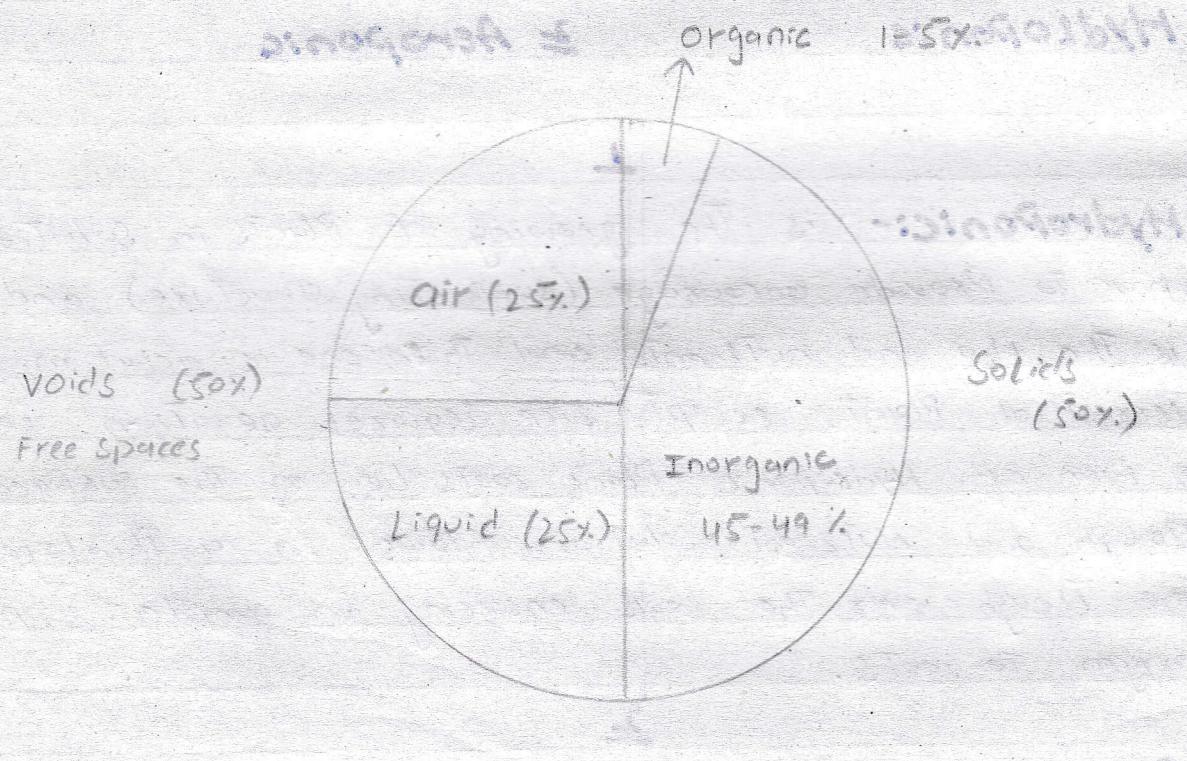
**Hydroponic:-** is The growing of Plants in solution. We have to provide anchorage (supporting structure) and second is The H<sub>2</sub>O and nutrients and third one is aeration. All Terrestrial Plants except rice requires aeration. In another form of Hydroponic Plant roots lie on the surface of trough and nutrient solution flows in a thin layer along the trough over the roots ensuring an ample supply of oxygen to roots.

2

**Aeroponic:-** Air culture

Plants are grown with their roots suspended in air while being sprayed continuously with a nutrient solution with comparatively high level of nutrients than Hydroponics.

It is mostly used for experimental purpose.



## Exercise No 3:-

### Soil :-

Upper loose portion of the earth crust which supports plant life by providing them with nutrients, water and air and mechanical support.

1 Voids content (Free spaces) 50%.

2 Solid content 50%.

1

**Void Content :-** It contains 25% air spaces and 25% liquid spaces.

2

**Solid content :-** consist of 2 major portion:-

1 organic (1-5%)

2 Inorganic (45-49%)

**In-organic** contains 3 contents :-

1 Sand 0.2 - 0.02 mm

2 Silt 0.02 - 0.002 mm

3 clay < 0.002 mm

### Organic (soil colloidal Particles) :-

Soil Active material, exchange complex, Heart of soil.

Clay and organic particles that are so small that tend

To remain suspended in standing H<sub>2</sub>O are called soil

Colloidal Particles. All the physical, chemical and Bio-

logical activities of soil are controlled by soil colloidal

Particles. That's why these are known as heart of soil.

Per unit weight of any material that is exposed to external surface.

### Cation Exchange :-

The interchange b/w cation in soil solution & other cation

on the very active soil surface. Particles such as clay, colloidal or organic colloids & b/w 2 colloids if they are in close contact with each other.

### Cation Exchange Capacity :-

The sum total of exchangable cation that a soil can absorb at a specific pH. It is usually reported in centimoles (cmol) of charge per kg dry soil ( $\text{cmol kg}^{-1}$  dry soil) or milliequivalent / 100 grams ( $\text{me 100g}^{-1}$ ).

Table of elemental conc in stock & working solution

SR	Macronutrients	M.WT	M OF SS	VOLUME OF SS / 1L2 OF Final sol	Elements
1	KNO <sub>3</sub>	101.1	1 M	6ml/L H <sub>2</sub> O	K, N
2	(Ca(NO <sub>3</sub> ) <sub>2</sub> .4H <sub>2</sub> O	236.16	1 M	4ml/ "	Ca, N
3	(NH <sub>4</sub> ) <sub>2</sub> PO <sub>4</sub>	115.08	1 M	2ml/u	NH <sub>4</sub> , P
4	MgSO <sub>4</sub> .7H <sub>2</sub> O	246.49	1 M	1ml/u	Mg, S
5	Micronutrients (all in one bottle)				
	KCl	74.55	25 mM	2.0mL	K, Cl
	H <sub>3</sub> BO <sub>3</sub>	61.84	12.5 mM	"	B
	MnSO <sub>4</sub> .H <sub>2</sub> O	169.01	1 mM	"	Mn, S
	ZnSO <sub>4</sub> .7H <sub>2</sub> O	289.55	1 mM	"	Zn, S
	CuSO <sub>4</sub> .5H <sub>2</sub> O	249.71	0.25 mM	"	Cu, S
	H <sub>2</sub> MoO <sub>4</sub>	161.97	0.25 mM	"	Mo
6	Fe DTPA	346.08	64 mM	0.3-1.0mL	Fe

## Exercise NO 4:-

### Hoagland's nutrient Solution:-

Epstein, 1972

#### Procedure :-

##### Stock solution :-

- 1 TAKE 6 PLASTIC BOTTLES AND WASH THEM THOROUGHLY. LABEL EACH BOTTLE FROM 1 TO 6 OR AS DESIRED.
- 2 PREPARE MOLAR SOLUTION OF MACRO NUTRIENTS AND MMJ SOLUTIONS FOR MICRONUTRIENTS BY DISSOLVING THE QUANTITY GIVEN IN THE "AMOUNT REQUIRED FOR SS" COLUMN.
- 3 PUT EACH NUTRIENT STOCK SOLUTION IN A SEPARATE BOTTLE. ALL MACRONUTRIENTS WILL BE COMBINED IN ONE BOTTLE. DO NOT MIX UNLESS NEEDED.
- 4 STORE IN A REFRIGERATOR AT 4°C.
- 5 THESE CALCULATIONS ARE PER LITER BASIS. TO CALCULATE A DIFFERENT MOLARITY YOU WILL NEED TO RECALCULATE THE GIVEN QUANTITIES.

##### Working solution :-

- 1 TAKE ONE LITER OF H<sub>2</sub>O IN OPEN CONTAINER.
- 2 USE THE GIVEN QUANTITY SS FROM EACH BOTTLE AS SHOWN IN "VOLUME OF STOCK SOLUTION PER LITER OF FINAL SOLUTION" OF THE TABLE. YOU WOULD NEED 6 mL OF KNO<sub>3</sub> FROM BOTTLE 1 PER LITER OF H<sub>2</sub>O.
- 3 IF YOU WISH TO PREPARE THE HALF STRENGTH HOAGLAND'S NUTRIENT SOL, SIMPLY DOUBLE THE QUANTITY OF TAP H<sub>2</sub>O. OR USE HALF QUANTITY OF STOCK.

## Precautions:-

### For STOCK SOLUTION

- 1 Use laboratory grade salts to prepare stock solution.
- 2 Keep each SS in a separate bottle and don't mix before use.
- 3 Keep the stock bottles air locked.
- 4 Never mix conc. stock solution before use.
- 5 Never use SS if you observe any precipitation.
- 6 The shelf life of SS is about 6 months unless any precipitation occurs earlier.

### For working solution:-

- 1 Freshly prepare working solution just before use by mixing the given quantity.
- 2 Never apply working solution if any precipitation.
- 3 Never store the working solution more than 3 days.
- 4 Check the pH of working sol, if necessary adjust to pH 5.8 to 6.3 with 1M KOH or HCl.

**pH OF NUTRIENT SOLUTION :-** Depends on nature of growing media, pH of nutrient sol is altered over time. For example in sand it goes acidic over a week. It may cause alterations in nutrient availability that is observed as leaf chlorosis. It is suggested to replace the nutrient solution by draining by tap  $H_2O$  once a week and replace with fresh nutrient solution.

## Exercise NO 5:-

### Deficiency symptoms of different nutrients.

#### Nitrogen deficiency symptoms:- (N)

- 1 Chlorosis and necrosis of older leaves. Chlorosis is loss of green colour and necrosis is death of tissues.
- 2 Some times C:N ratio becomes high when there is no N assimilation.
- 3 Excessive carbohydrates are converted into anthocyanine and give purple shade or purple coloration in plants.

Excessive symptoms are :-

- 1 Dark green succulent leaves.
- 2 Abundant foliage.
- 3 Poorly developed root system.
- 4 High shoot to root ratio.
- 5 Delayed maturity.
- 6 Susceptible to disease and insect pest.

#### Potassium deficiency symptoms:- (K)

- 1 In severe cases chlorosis and necrosis of the leaf margin and tips occur.
- 2 Lodging of plants.
- 3 Reduce disease resistance.
- 4 Reduce winter hardness in perennial or winter annual.
- 5 Quality of fruit / grain is affected.

## Magnesium deficiency symptoms:- (Mg)

- 1 Pale green yellow older leaves by gradual chlorosis due to lack of chlorophyll.
- 2 Interveinal chlorosis.
- 3 In some crops upward curling of leaves.
- 4 Weak stalk & long branched roots.
- 5 Pre harvest leaf drop.
- 6 Mg<sup>+</sup> toxicity does not occur if toxicity occurs the photosynthetic rate is reduced.

## Calcium deficiency symptoms:- ((a))

- 1 Necrosis leading to stunted growth.
- 2 Curling of leaves occurs.
- 3 Death of terminal buds and root tips.
- 4 Reduced height, fewer nodes, less leaf area.

## Sulphur deficiency symptoms:- (S)

- 1 Just like N chlorosis occurs. It is defined as loss of green colour. It occurs in younger leaves.
- 2 Necrosis occurs in younger leaves. Necrosis is the death of tissues.

## Phosphorus deficiency symptoms :- (P)

- cause root diseases
- slow growth & late maturity.
- leaf tips may die back in severe conditions.

## Micronutrients :-

### Boron :- (B)

- 1 IT IS Phloem immobile so deficiency symptoms appear on younger leaves.
- 2 Black necrotic spot on leaves & buds.
- 3 Stem stiffness.
- 4 loss of apical dominance
- 5 Necrotic spot on fruits, fleshy roots & tubers.

### Zinc :- (Zn)

- Interveinal chlorosis leading to white necrotic spots.
- Stunted growth due to Auxin deficiency.
- leaf distortion reduce size.
- Rosette plant.
- Mortality of Plant

### Iron (Fe) :-

- Interveinal chlorosis of younger leaves because it is immobile.
- fruit would be of poor quality & quantity.

## Manganese (Mn) :-

- Intervenital chlorosis associated with development of necrotic spot.
- Necrotic spot on both younger and older leaves.
- Reduced or stunted growth.

## Copper (Cu) :-

- Production of dark green leaves.
- Necrotic spot on younger leaves.
- Premature abscission.

## Molybdenum (Mo) :-

- Intervenital chlorosis
- Flowering fails to occur.
- Premature flowers
- Fruit drop.

## Chlorine (Cl) :-

- Wilting of leaf tip
- Followed chlorosis and necrosis.
- bronzing of leaves.
- Stunted roots thickened near root tips.

## Nickel (Ni):-

- The seeds of Ni deficient plants are often unviable.
- Colorists of new leaves occur
- In legumes are exhibited as whole leaf chlorosis along with necrotic leaf tips.

## Exercise No 6:-

### Composition of Nitrogen, Phosphatic and Potash Fertilizers.

#### Nitrogen Fertilizers

1	Ammonium Sulphate	21.5% N
2	Ammonium Phosphate	11% N and P <sub>2</sub> O <sub>5</sub> 48%
3	Diammonium Phosphate (DAP)	18% N and 46% P <sub>2</sub> O <sub>5</sub>
4	Sodium nitrate	16% N
5	Nitrophos	23% N and P <sub>2</sub> O <sub>5</sub> 23%
6	Ammonium nitrate	33% Nitrate
7	Calcium ammonium nitrate (CAN)	26% Nitrogen
8	Urea	46% N

#### Phosphatic Fertilizers

1	SSP	16% P <sub>2</sub> O <sub>5</sub>
2	TSP	46% P <sub>2</sub> O <sub>5</sub>

All The phosphatic fertilizers are prepared from rock phosphate.

#### Potash Fertilizers

1	Potassium sulphate (K <sub>2</sub> SO <sub>4</sub> )	50% Potassium 17% Sulphate
2	SOP (Sulphate of Potash)	50% K <sub>2</sub> O
3	MOP (Muriate of Potash).	60% K <sub>2</sub> O

Calculate The amount of Fertilizers needed  
To be applied To The Field.

Numerical:-

Recommended dose OF N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O  
For wheat is 46 : 34 : 25 kg /ha. calculate  
The amount of urea, DAP, SOP needed to be  
Applied as Fertilizers on an area of 1  
acre.

Solution:-

Urea contains 46% N

DAP contains 18% N & 46% P<sub>2</sub>O<sub>5</sub>

SOP contains 50% K<sub>2</sub>O

### DAP

46 kg of P<sub>2</sub>O<sub>5</sub> is supplied by = 100 kg DAP.

So 34 kg of P<sub>2</sub>O<sub>5</sub> is supplied by =  $\frac{100}{46} \times 34$

$$= 73 \text{ kg. DAP.}$$

So 34 kg of P<sub>2</sub>O<sub>5</sub> is supplied by 73 kg of DAP.

100 kg of DAP supplies = 18 kg N

So, 73 kg of DAP supplies =  $\frac{18}{100} \times 73 = 13 \text{ kg.}$

Next N required = 46 - 18

$$= 33 \text{ kg N}$$

As 73 kg of DAP supplies 13 kg N so next N  
required is 33 kg.

Urea :-

46 Kg of N is supplied by = 100 Kg urea

33 Kg of N is supplied by =  $\frac{100}{46} \times 33$

$$= 71 \text{ Kg urea. remaining}$$

so, 71 Kg urea will supply 33 Kg of Nitrogen.

SOP :-

50 Kg of K<sub>2</sub>O is supplied by = 100 Kg SOP.

25 Kg of K<sub>2</sub>O is supplied by =  $\frac{100}{50} \times 25$

$$= 50 \text{ Kg SOP.}$$

so, 50 Kg SOP will supply 25 Kg of K<sub>2</sub>O.

## Exercise NO 7:-

To check the deficiency symptoms on maize and sunflower grown in the pots.

### Material required:-

- POTS
- Media (Sand)
- Seed (Maize and Sunflower).
- Water (as it is first germination requirement). Distilled.

### Procedure :-

- Four Pots are selected.
- Fill These Pots with Sand as we select Sand as a growing media.
- In Two Pots sow The maize seed. Sow almost Two maize seed. So that if one cannot able to germinate due to any reason other may germinate).
- Sow good quality seed, not damaged.
- In remaining Two Pots sow The sunflower seed. Sow almost Two seeds. Select good quality and hard seeds of sunflower. Check the seed in the following way:-

Place The Seed between Two Fingers or b/w Thumb & Finger and apply some Force. If it break don't sow it.

- weight The sand which should be filled in The Pot. The weight of our sand is 1.25 Kg.
- After sowing apply distilled water or sow The seed in water condition

The water should be applied according to requirement.

- left the pots and observe them
- ~~Be Bulk~~ Apply water when required.
- Prepare the fertilizers / nutrient solution and don't apply that nutrient whose deficiency is going to be checked.
- Apply the fertilizers when there is need and when ~~the~~ seedling achieve their enough growth.
- Don't apply nutrient whose deficiency is going to check.
- observe the deficiency symptoms.

Calculate The amount OF Fertilizer requirement For 1.25 Kg of soil in pot For maize and sunflower?

Solution :-

↓

Zinc :-

For maize

Recommended dose OF Zinc Per hectare For maize = 15 Kg.

Zinc sulphate ZnSO<sub>4</sub> = 23% Zn.

so,

23 Kg of Zn is supplied by = 100 Kg ZnSO<sub>4</sub>

$$15 \text{ Kg of Zn is supplied by} = \frac{100}{23} \times 15$$

$$= 65 \text{ Kg ZnSO}_4 / \text{hectare}$$

Soil weight of one hectare =  $2 \times 10^6$  Kg.

Zinc sulphate For  $2 \times 10^6$  Kg of soil = 65 Kg.

$$\text{" " " " " " " } = \frac{65}{2 \times 10^6} \times 1.25$$

$$= 0.0000407 \text{ Kg}$$

now convert it into g/cm.

$$1 \text{ Kg} = 1000 \text{ grams}$$

$$\text{so } = 0.0000407 \times 1000$$

$$= 0.0407 \text{ g.}$$

requirement of

so A zinc sulphate For 1.25 Kg of soil in pot  
For maize is 0.0407 grams.

### For sunFlower

Recommended dose of Zinc Per hectare for sunFlowers = 10Kg

$$ZnSO_4 = 23 \text{ g. Zn.}$$

So

23 Kg of Zn is supplied by = 100 Kg ZnSO<sub>4</sub>

$$10 \text{ Kg } " " " " " = \frac{100}{23} \times 10$$

$$= 43 \text{ Kg of ZnSO}_4/\text{ha}$$

Soil weight of one hectare =  $2 \times 10^6$  Kg.

Zinc sulphate for  $2 \times 10^6$  Kg soil = 43 Kg.

$$" " " " 1.25 \text{ Kg } " = \frac{43}{2 \times 10^6} \times 1.25$$

$$= 0.0000269 \text{ Kg}$$

$$= 0.0000269 \times 1000$$

$$= 0.0269 \text{ g}$$

Convert it into g

So 1.25 Kg of soil in pot requires 0.0269 g  
of zinc sulphate for sunFlowers.

### 2 Phosphorus :-

#### For maize

Recommended dose of P<sub>2</sub>O<sub>5</sub> Per acre For maize = 46Kg

$$" " " " " " \text{ hectare } " " = 46 \times 2.5$$

$$= 115 \text{ Kg/ha.}$$

$$SSP = 16: P_2O_5.$$

So

16 Kg of P<sub>2</sub>O<sub>5</sub> is supplied by = 100 Kg SSP

$$115 " " " " " " = \frac{100}{16} \times 115$$

$$= 718 \text{ Kg /ha SSP.}$$

Soil weight of one hectare =  $2 \times 10^6 \text{ Kg}$

SSP For  $2 \times 10^6 \text{ Kg}$  of soil =  $718 \text{ Kg.}$

$$\text{Soil weight} = \frac{718}{2 \times 10^6} \times 1.25$$

$$= 0.000359 \times 1.25$$

$$= 0.000449 \text{ Kg}$$

Convert into grams

$$= 0.000449 \times 1000$$

$$= 0.449 \text{ g}$$

So  $1.25 \text{ Kg}$  of soil requires  $0.449 \text{ g}$  of SSP  
For ~~soyab.~~ maize.

### For SunFlower

Recommended dose of P per hectare For sunFlowers =  $40 \text{ kg}$

$$\text{SSP} = 16 \text{ P}_2\text{O}_5$$

$16 \text{ kg}$  of  $\text{P}_2\text{O}_5$  is supplied by =  $100 \text{ kg SSP}$

$$40 \text{ " " " " " } = \frac{100}{16} \times 40$$

$$= 250 \text{ Kg /ha}$$

Soil wt of one hectare =  $2 \times 10^6 \text{ Kg}$

SSP For  $2 \times 10^6 \text{ Kg}$  of soil =  $250 \text{ Kg}$

$$\text{Soil weight} = \frac{250}{2 \times 10^6} \times 1.25$$

$$= 0.000157 \text{ Kg}$$

Convert into grams

$$= 0.000157 \times 1000$$

$$= 0.157 \text{ g.}$$

So  $1.25 \text{ Kg}$  of soil requires  $0.157 \text{ g}$  of SSP For sunFlowers.