SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Subject Code: 19BY701

Subject: Biology for Engineers /

GENETICS AND IMMUNE SYSTEM

Unit-III

Topic: Genetics and Immune System

Plant Nutrients

- Nutrients in the soil can be supplemented through the application of fertilizers or manures.
- Nutrient management includes the type of fertilizer to be applied, rate of application and method of application.
- Nutrients are taken up by the fine root hairs, not by the big roots.
- Even the very largest of trees have many small, fine root hairs to absorb the nutrients and water they need.
- The larger roots are used for supporting the tree and for storage of water and other plant food.
- There are a total of 17 nutritive elements, which are necessary for the growth of plants.

Continue….

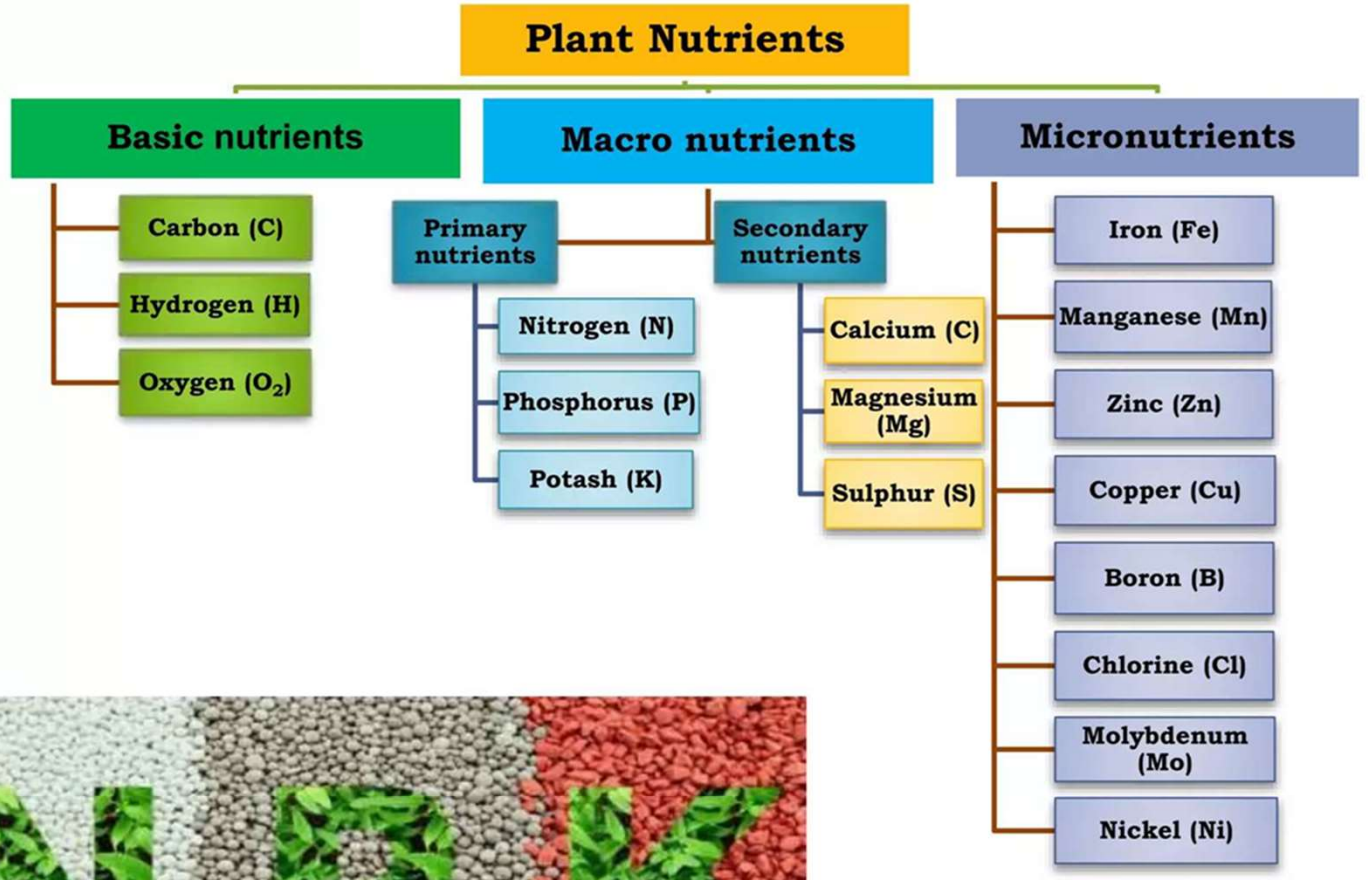
- All elements are equally important irrespective of their requirement or presence in a plant. According to **Arnon and Stout (1939)**, an element must meet the following three criteria:

a. **A plant cannot complete its life cycle in the absence of that mineral element.**

b. **The element is specific and cannot be replaced.**

c. **The element must be directly**

Classification of Plant Nutrients



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- Nutrients can be classified according to their requirement and importance in plant life.
- They can be classified into basic nutrients, macro-nutrients and micro-nutrients.

Basic nutrients: Carbon (C), Hydrogen (H) and Oxygen (O). These elements are obtained from air and water.

Macro-nutrients:

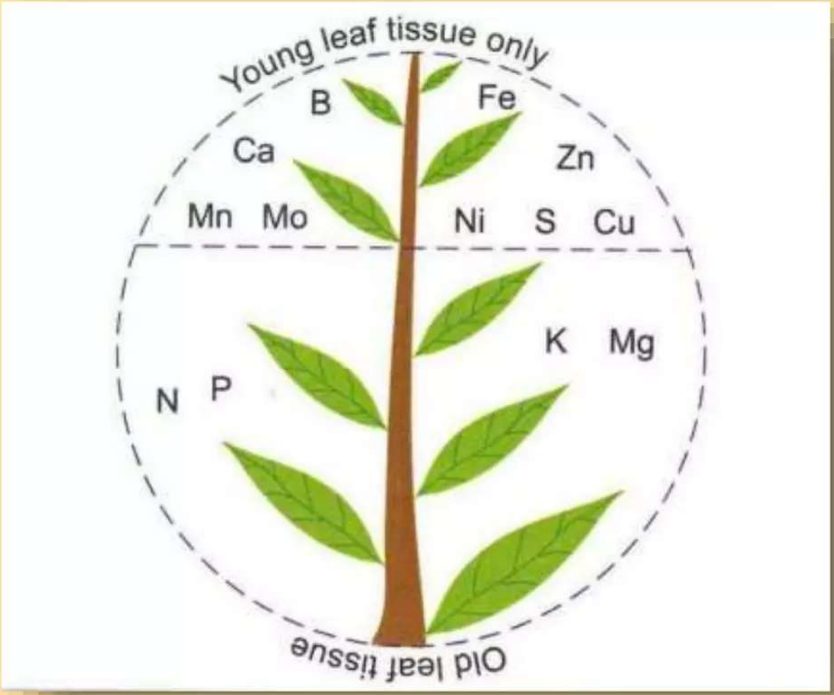
- **Primary nutrients**: These consist of Nitrogen, Phosphorus and Potassium. These nutrients are supplied through fertilizers.
- **Secondary nutrients:** Calcium, Magnesium and Sulphur.

Micro-nutrients:

- They are also known as minor or trace elements. They include Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Chlorine (Cl), Boron (B) Molybdenum (Mo) and Nickel (Ni).

Continue…

- Non-mineral elements**:** Carbon (C), Hydrogen (H) and Oxygen (O).
- Primary nutrients: Nitrogen (N), Phosphorus (P) and Potassium (K).
- Secondary nutrients: Calcium (Ca), Magnesium (Mg) and Sulphur (S).
- Energy exchange: Hydrogen (H) and Oxygen (O).



Plant Nutrient Deficiency Terminology

- Burning: severe localized yellowing; scorched appearance.
- Chlorosis: general yellowing of the plant tissue; lack of chlorophyll.
- Generalized: symptoms not limited to one area of a plant, but rather spread over the entire plant.
- Immobile nutrient: not able to be moved from one part of the plant to another.
- Interveinal Chlorosis: yellowing in between leaf veins, yet veins remain green.
- Localized: symptoms limited to one leaf or one section of the leaf or plant.
- Mobile nutrient: able to be moved from one plant part to another.
- Mottling: spotted, irregular, inconsistent pattern.
- Necrosis: death of plant tissue; tissue browns and dies.
- Stunting: decreased growth; shorter height of the affected plants.
- Hidden hunger: plants that shows no symptoms of deficiency.

Nutrients, functions and deficiency symptoms

Nitrogen (N)

Functions:

- Promotes the growth of leaves and stems.
- Enhances the dark green colour in plants and improves the quality of foliage.
- Necessary for the development of cell protein and chlorophyll.
- Improves the uptake of other nutrients, like phosphorus, potassium, magnesium and sulphur.

Deficiency symptoms

- Loss of vigour and yellowing of green parts.
- Shortening of the stem, leaves become pale yellow and remain small in size.
- Slow growth and a plant becomes dwar
- On excess show dark green color and luxurious vegetative growth.

Nutrients, functions and deficiency symptoms

Phosphorus (P)

Functions:

- Stimulates early formation and growth of roots.
- Provides for fast and vigorous growth and speedy maturity.
- Increases number of tubers.
- Necessary for the enzyme action of many plant processes.

Deficiency Symptoms

- Growth of plant is retarded at early stages.
- Older leaves are curled and purplish color.
- Some time marginal scorching.
- Slow maturity vegetative growth continues beyond normal time.
- Delayed tuberization.

Continue….

Potassium (K)

Functions

- Helps in carbohydrates and protein synthesis.
- Helps in the transfer of carbohydrates from leaves to roots.
- Increases disease resistance, vigour and hardiness to drought and frost.
- Increases yield by increasing the size of tubers, hence, important for processing cultivars.

Deficiency symptoms

- Coincides with the onset of tuber initiation.
- Deficiency symptoms appear as dark bluish green leaves and shortened internodes.
- Terminal leaves show bronzing accompanied by necrotic spots.

Continue….

Sulphur (S)

Functions

- Promotes root growth and vigorous vegetative growth.
- Essential for protein formation .

Deficiency symptoms

- Shoots become light green; veins on the leaves also turn yellowing of leaves.
- Yellowing starts from upper leaves and the plant shows chlorosis.
- Severe deficiency results in reddening of the stem and curling of leaves inwards.

Continue….

Calcium (Ca)

Functions

- Improves plant vigour .
- Influences the intake and synthesis of other plant nutrients
- Improves specific gravity of tubers, and thus, enhances tuber quality for processing.

Deficiency symptoms

- Failure of development of terminal buds at apical tips
- Small leaves.
- leaves do not develop normally and have wrinkled appearance.
- In mild deficiency, a light green band appears along the margin of leaves of terminal buds.

Continue….

Magnesium (Mg)

Functions

- Influences the intake of other essential nutrients
- Helps in the assimilation of fats.
- Assists in the translocation of phosphorus and fats

Deficiency symptoms

- green parts between veins in leaves become pale, though the veins remain green (Interveinal chlorosis).
- leaf tips curl up.
- leaflets become thick and roll upwards.

Continue….

Zinc (Zn)

Functions

- Synthesis of tryptophan.
- Helps in enzyme action.
- Essential for protein synthesis and seed production. Fastens the rate of maturity.

Deficiency symptoms

- Younger leaves become yellow.
- Leaves show inter-veinal necrosis, while midrib remains green.
- In tomato, small narrow yellow leaves with black spots appear and there is stunted growth in plants.

Continue….

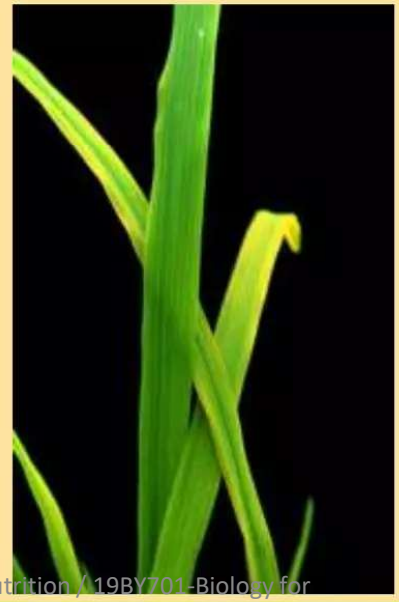
Iron (Fe)

Functions

- Essential in the enzyme system of plant metabolism.
- Essential for the synthesis of enzymes responsible notes for chlorophyll synthesis in plants.

Deficiency symptoms

- Yellowing of younger leaf blades, while veins and petioles remain green.
- Affected plants remain small and do not respond well to normal fertilizer treatments.



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Manganese (Mn)

Functions

- Helps in the oxidation-reduction process during photosynthesis.
- Essential element in respiration.

Deficiency symptoms

- Plants show a light inter-veinal chlorosis of leaves.
- Mature leaves when observed in light show netted veins.
- Appearance of chlorotic and necrotic spots in inter-veinal areas of leaves.

Continue….

Copper (Cu)

Functions

- Essential for the synthesis of chlorophyll and other plant pigments
- Helps improve the flavour and the content of sugar in vegetables.
- Increases the dark green colour of leaves and also the crop yield.

Deficiency symptoms

- Necrosis on the tip of young leaves along the margin.
- Defoliation.
- Leaves of deficient plants curl up and their petioles bend downwards.

Continue….

Molybdenum (Mo)

Functions

- Involved in nitrogen fixation and nitrate assimilation.

Deficiency symptoms

- Chlorotic inter-veinal mottling of lower leaves followed by marginal necrosis and infolding of leaves.
- Wilting of leaves.
- In cauliflower, the lamina of new leaves fails to develop and gives a whiptail appearance.

Continue….

Boron (B)

Functions

- Helps in the synthesis of the bases of RNA (ribonucleic acid)
- Promotes root growth
- Enhances pollen germination and pollen tube growth, thereby, improving fruiting.

Deficiency symptoms

- Loss of apical dominance
- Leaf blades develop pronounced crinkling
- Darkening and crackling of petioles
- Syrupy exudation from leaf blades

Continue….

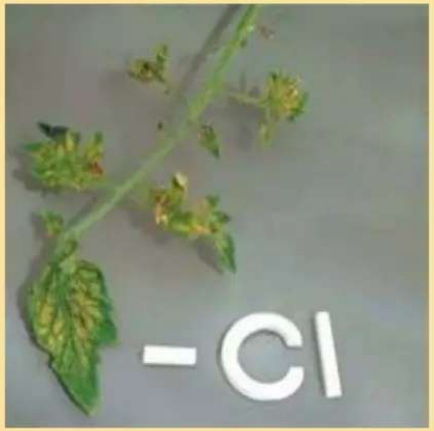
Chlorine (Cl)

Functions

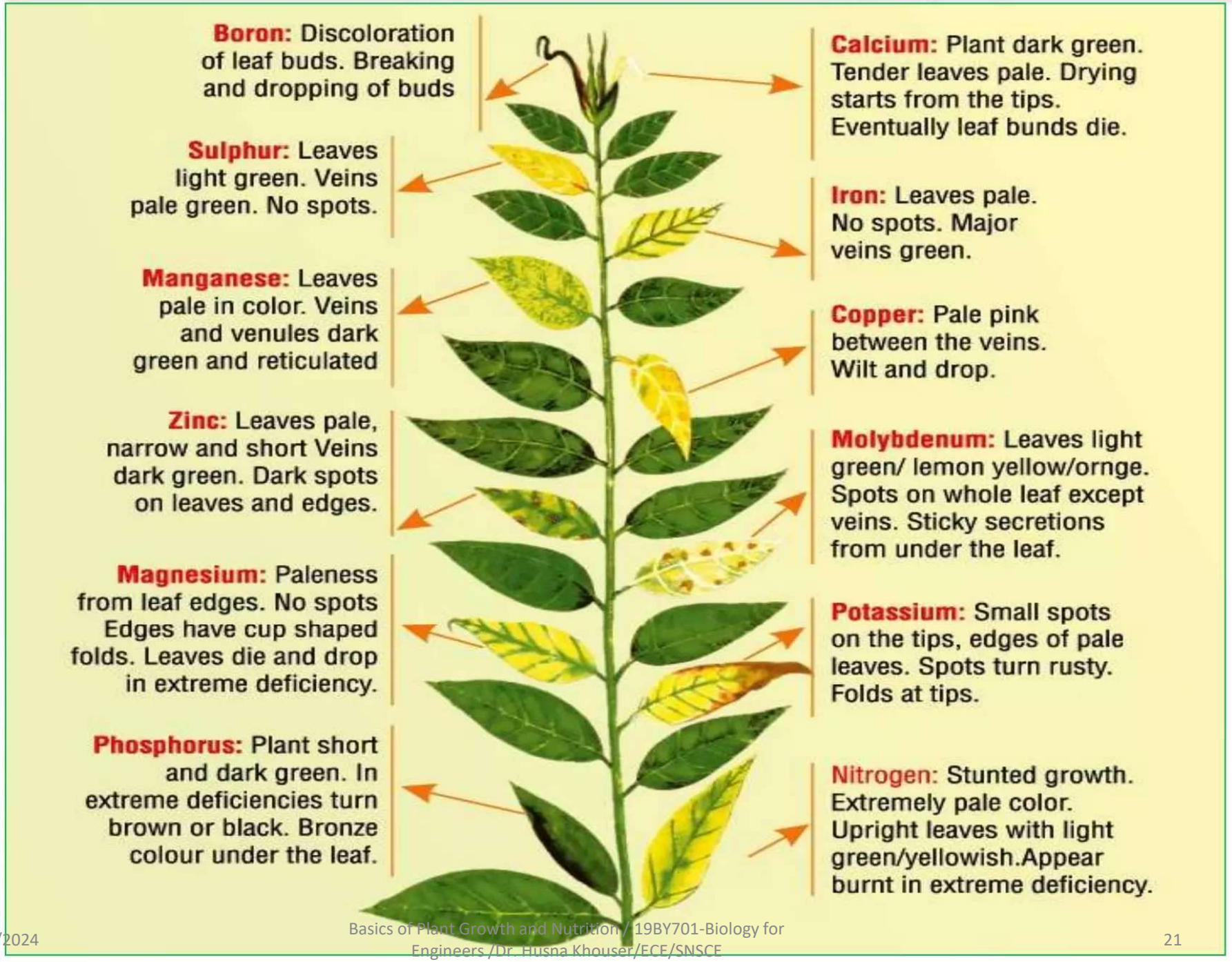
- Has a direct role in photosynthesis
- Necessary for shoot apex and root growth

Deficiency symptoms

- Chlorosis and wilting of young leaves
- Chlorosis of the inter-veinal area of leaf blade
- In severe deficiency, bronzing of the mature leaves on upper surface.



Macro & micro nutrient deficiency symptoms



Principal Forms of Nutrient Uptake

CATIONS			ANIONS		
Element	Chemical Symbol	Plant Available Forms	Element	Chemical Symbol	Plant Available Forms
Nitrogen (Ammonium)	NH_4	NH_4^+	Nitrogen (Nitrate)	NO_3	NO_3^-
Potassium	K	K^+	Phosphorus	P	PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$
Calcium	Ca	Ca^{2+}	Sulfur	S	SO_2, SO_4^{2-}
Magnesium	Mg	Mg^{2+}	Boron	B	H_3BO_3, $B_4O_7^{2-}$
Iron	Fe	Fe^{2+}, Fe^{3+}	Molybdenum	Mo	MoO_4^{2-}
Manganese	Mn	Mn^{2+}	Chlorine	Cl	Cl^-
Zinc	Zn	Zn^{2+}			
Copper	Cu	Cu^+, Cu^{2+}			

Macronutrients. Micronutrients.

Diseases or Symptoms caused due to deficiency of nutrients in plants

S.No.	Deficiency of nutrient	Cause diseases/ symptoms
1	N	Buttoning in cauliflower
2	Ca	Cavity spot in carrot
3	Cu	Dieback and little leaf in citrus
4	Bo	Internal necrosis in aonla, browning in cauliflowers, tomato cracking
5	Zn	Whit bud in maize, Khaira disease in paddy
6	Mn	Spotted yellow disease in sugarcane
7	Mo.	Whiptail in cauliflower.

Indicator crop plants for various nutrient deficiency

Deficient elements	Indicator plant/crops
N	Maize, Mustard, Small Millets
P	Maize, Barley
K	Maize, Potato, Tobacco, Beans
Ca	Lucerne, legumes,
Mg	Potato, Maize, Oat, Wheat, Pea, Bean
Fe	Sorghum, Barley
S	Lucerne, Mustard,
Bo	Sunflower, Lucerne
Mo	Oat, Brassica sp.
Na	Sugerbeet
Mn	Oat, Sugerbeet

Calculation Fertilizer requirement:

$$\text{Fertilizer required} = \frac{100}{\text{nutrient content}(\%)} \times \text{Recommended dose of fertilizer}$$

- In case of Urea= $\frac{100}{46}$ = 2.17 (factor)
- DAP (for N)= $\frac{100}{18}$ = 5.55
- DAP (for phosphorus)= $\frac{100}{46}$ = 2.17
- SSP= $\frac{100}{16}$ = 6.25
- MOP= $\frac{100}{60}$ = 1.67

FERTILIZER	NUTRIENT %	FACTOR
UREA	46% N	2.17
SSP	16% P_2O_5	6.25
MOP	60% K_2O	1.67
DAP	18% N	5.55
	46% P_2O_5	2.17

Continue….

1. The recommended dose of fertilizer is 120:60:40 kg/ha. Calculate how much Urea, SSP & MOP will be required for this.

Solution:

Fertilizer requirement will be,

- **Urea =120×2.17= 260.4 kg/ha**
- **SSP= 60×6.25= 375 kg/ha**
- **MOP= 40×1.67= 66.67 kg/ha**


THANK
YOU