Hydroponic Nutrients

Online Training of Hydroponic Vegetable Cultivation

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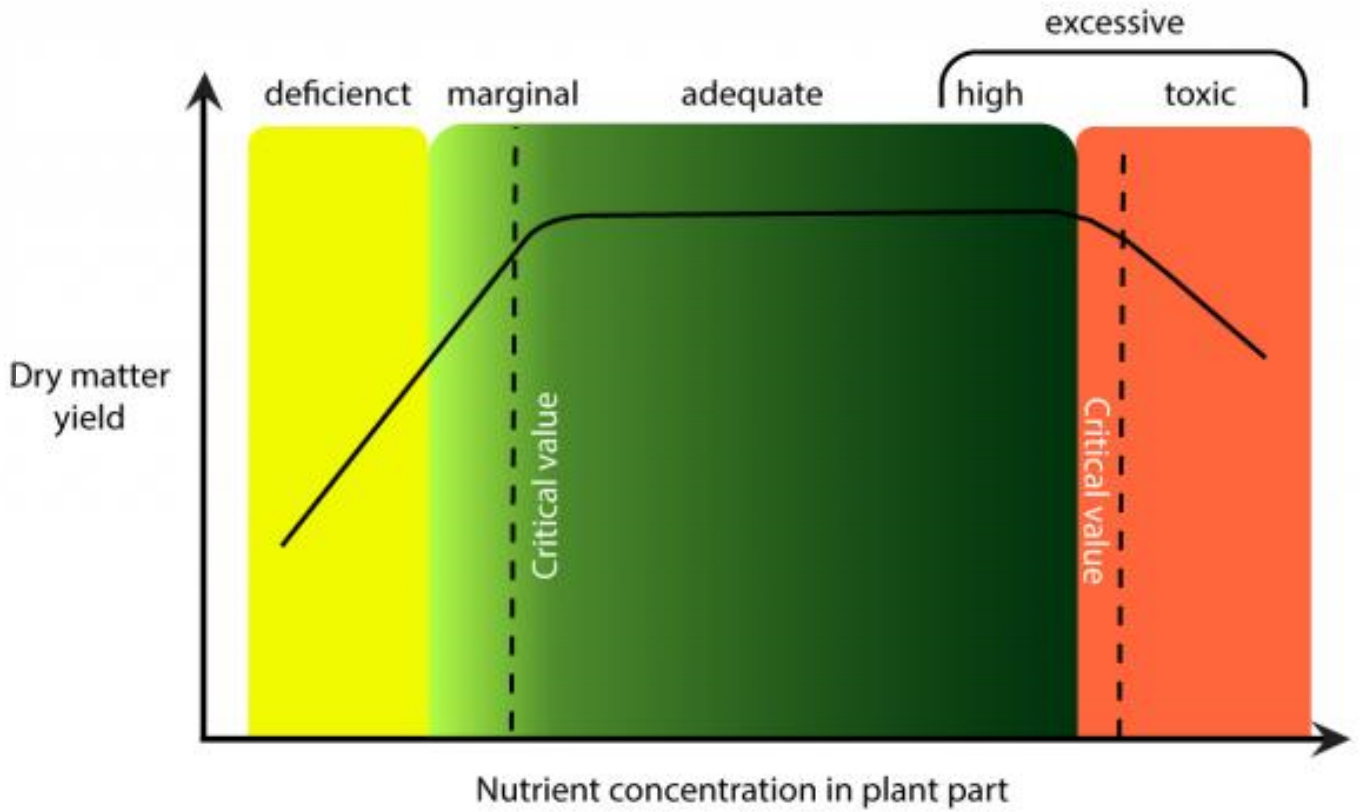
ICAT Lembang

Soil as reservoir of essential elements:

Soil consists of a wide variety of substances. It not only supplies minerals but also harbours nitrogen fixing bacteria, other microbes, holds water, supplies air to the roots.

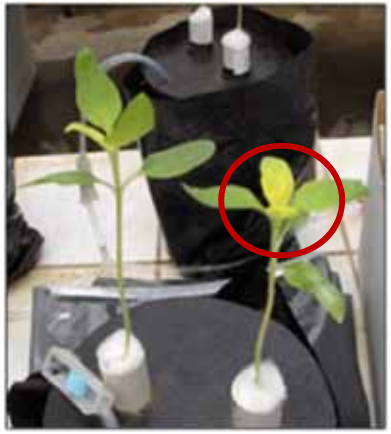


The key to successful management of a fertilizer program is to ensure adequate concentrations of all nutrients throughout the life cycle of the crop.

Hydroponic used for nutrient experiment?

- In this experiment roots of the plants were immersed in nutrient solutions.
- In this case element was added/removed or given in various concentration and then a nutrient solution suitable for the plant growth was determined.
- The nutrient solution must be adequately aerated to obtain the optimum growth.

- N



- Fe

Practical class
in crop science
Laboratory

Criteria for essentiality of nutrients:

- In the absence of element plant will not complete its life cycle or set the seeds.
- The requirement of the element must be specific and cannot be replaced by other element.
- There is correlation between mineral and plant metabolism.

Hydroponic Nutrient

Plant Nutient

Macro Nutrient

Nitrogen (N)
Phosphorus (P)
Potassium (K)
Magnesium (Mg)
Sulfur (S)
Calcium (Ca)

C, H, O

Micro Nutrient

Iron (Fe)
Manganese (Mn)
Boron (Bo)
Zinc (Zn)
Chlorin (Cl)
Molybdenum (Mo)
Copper (Cu)

Based on functions of essential elements they are classified under four categories:

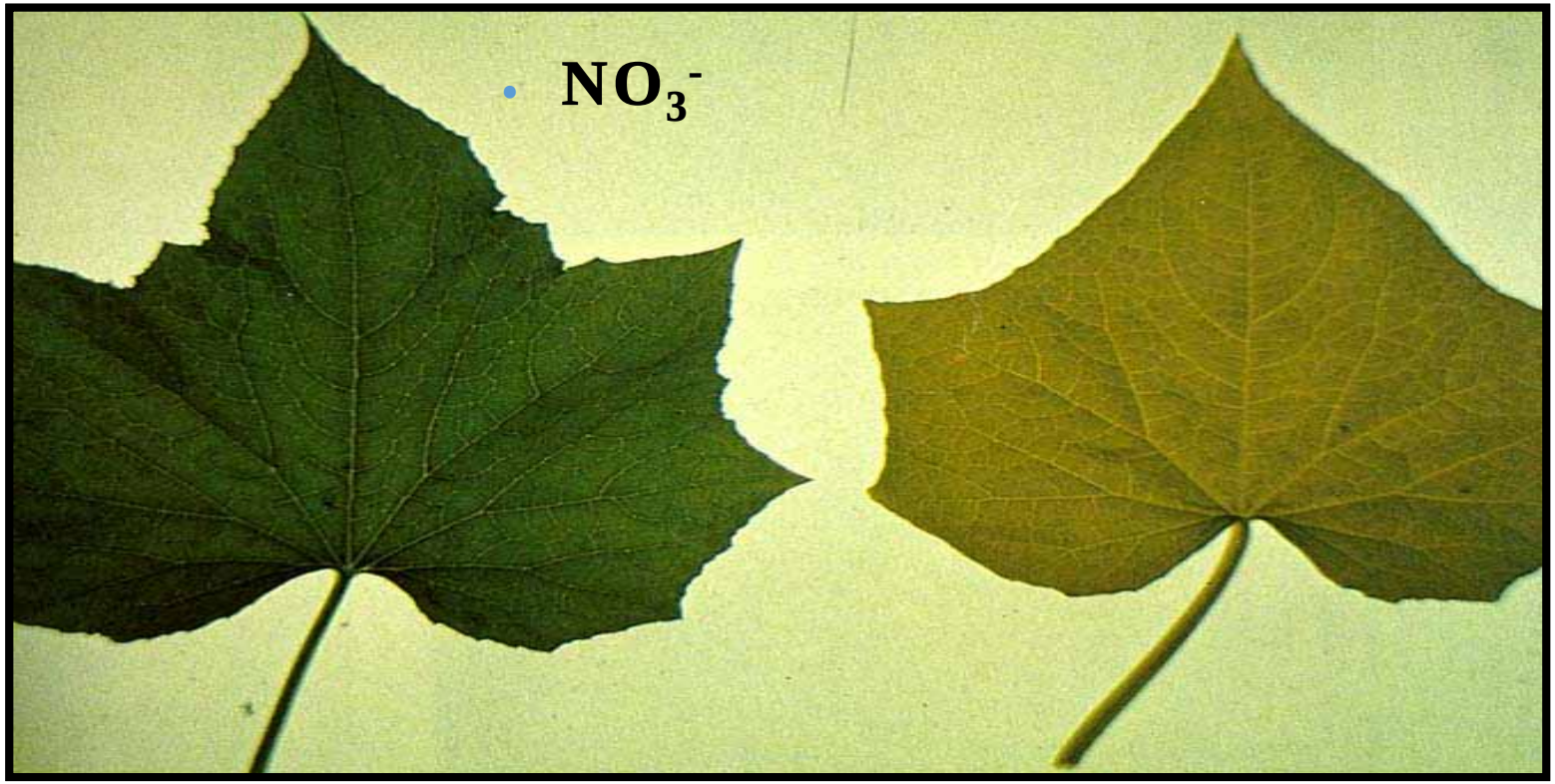
- Essential elements as components of Biomolecules. E.g. Carbon, hydrogen, oxygen and nitrogen.
- Essential elements that are components of energy related chemical compounds in plants. E.g. Magnesium in chlorophyll and phosphorus in ATP.

- Essential elements that activate or inhibit enzyme. E.g. Mg ion and Zn ion.
- Essential elements that can alter the osmotic potential of a cell. E.g. Potassium .It plays an important role in opening and closing of stomata

Role of micro and macronutrients:

Nitrogen:

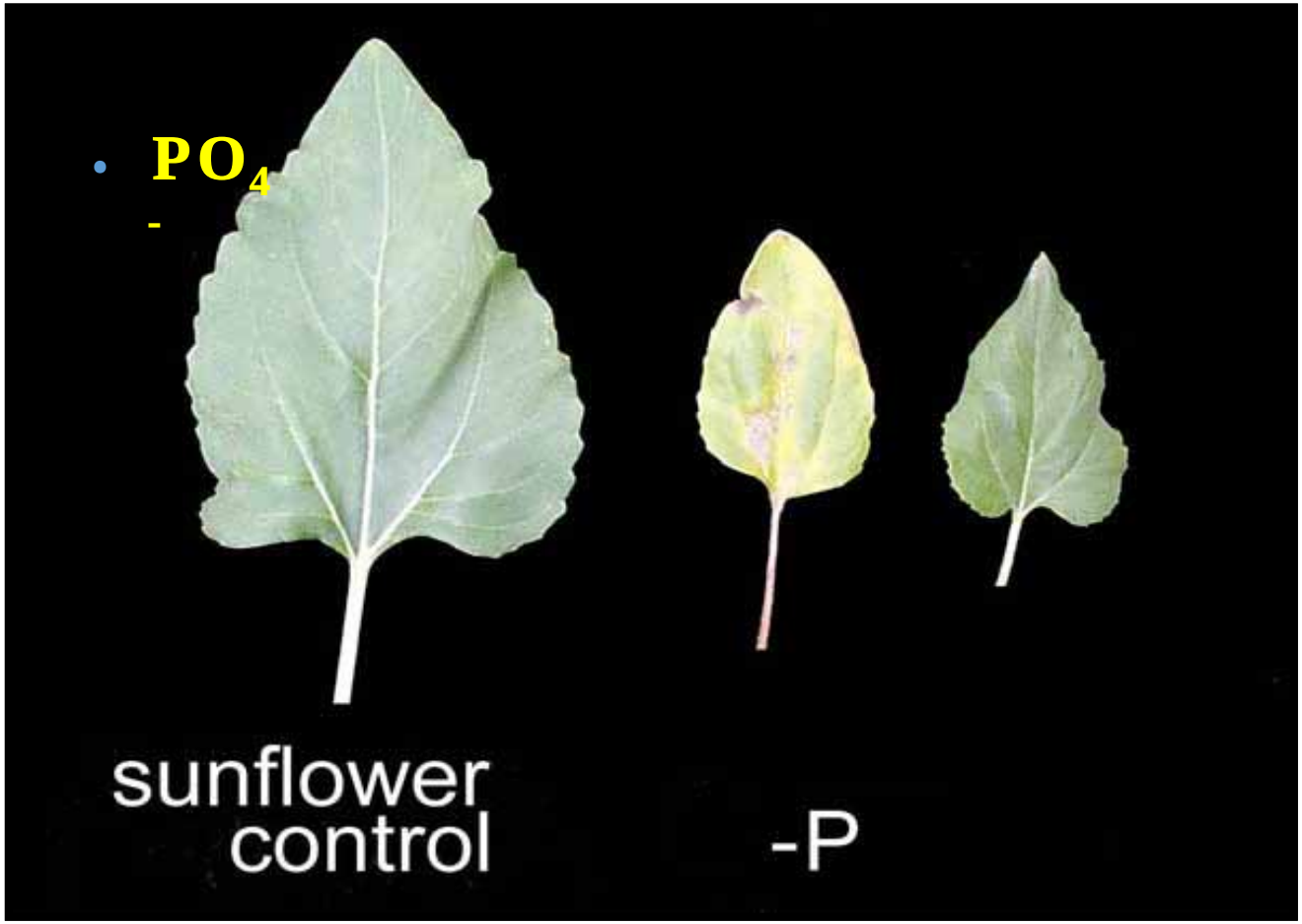
- It is absorbed as NO_3^- ,NO_2^- , or NH_4^+
- Require by plants in greatest amount and for all parts, meristematic & metabolically active cells.
- Important constituent of proteins, nucleic acids, vitamins and Hormones.



- **Deficiency: Poor growth and leaf yellowing**
- **Nitrogen (nitrate ions: Needed to make proteins and chlorophyll**

Phosphorous:

- It is absorbed in the form of phosphate ions in the form $H_2PO_4^-$, or HPO_4^{2-}
- Constituent of certain proteins, cell membrane, all nucleic acid, nucleotides.
- Required for all phosphorylation reactions.



- **Phosphorous: Required for photosynthesis and respiration**
- **Deficiency: Poor root growth and purple younger leaves**

POTASSIUM:

- It is absorbed as K^+ ions.
- Require for meristematic tissues, buds, leaves, and root tips.
- Helps in Protein synthesis, Opening and closing of stomata.
- Helps in activation of enzymes.
- It maintains the turgidity of cells.

- **Potassium: Helps enzymes in photosynthesis and respiration**

- **Deficiency: Yellow leaves with dead spots**

Calcium:

- Absorbed in the form of Ca^{2+}.
- Required by meristematic and differentiating tissues.
- During cell division it is used in synthesis of cell wall.
- Required for mitotic spindle formation.
- Activation of enzymes.


-Ca

Magnesium:

- Absorbed in the form of Mg^{2+}.
- Activates enzymes of respiration and photosynthesis.
- Involved in synthesis of DNA and RNA.
- Helps to maintain ribosome structure.

- **Magnesium is required as part of the chlorophyll molecule**
  - **Deficiency: Yellowing of leaves and poor growth**

- **Sulphur:**
  - Absorbed in the form of SO_4^{2-}.
  - Present in cystein and methionine amino acids.
  - Present in vitamins (thiamine, biotin, Coenzyme A) and ferredoxin.


-S

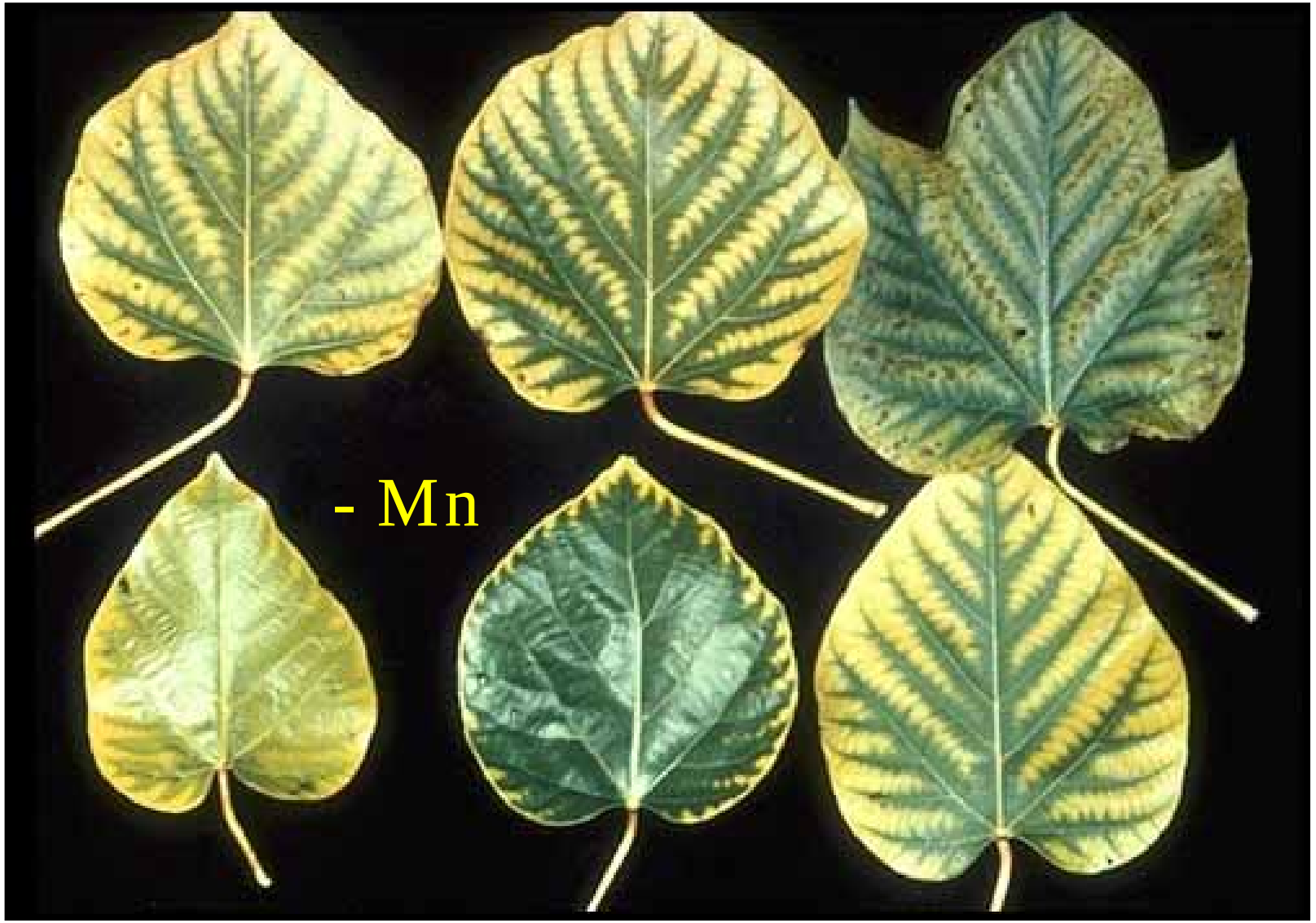
- **Iron:**
  - Absorbed in the form of Fe^{3+} (Ferric ion)
  - Important constituent of proteins.
  - Involved in the transfer of electrons like ferredoxin and cytochromes.
  - Activates catalase enzyme.
  - Essential for formation of chlorophyll.

- Iron is required by the enzymes that make chlorophyll

- Deficiency: Leaf yellowing

Manganese:

- Absorbed in the form of manganous ion (Mn^{2+}).
- Helps in activation of enzyme during photosynthesis, respiration and nitrogen metabolism.
- Helps in splitting of water to liberate oxygen during photosynthesis.


- Mn

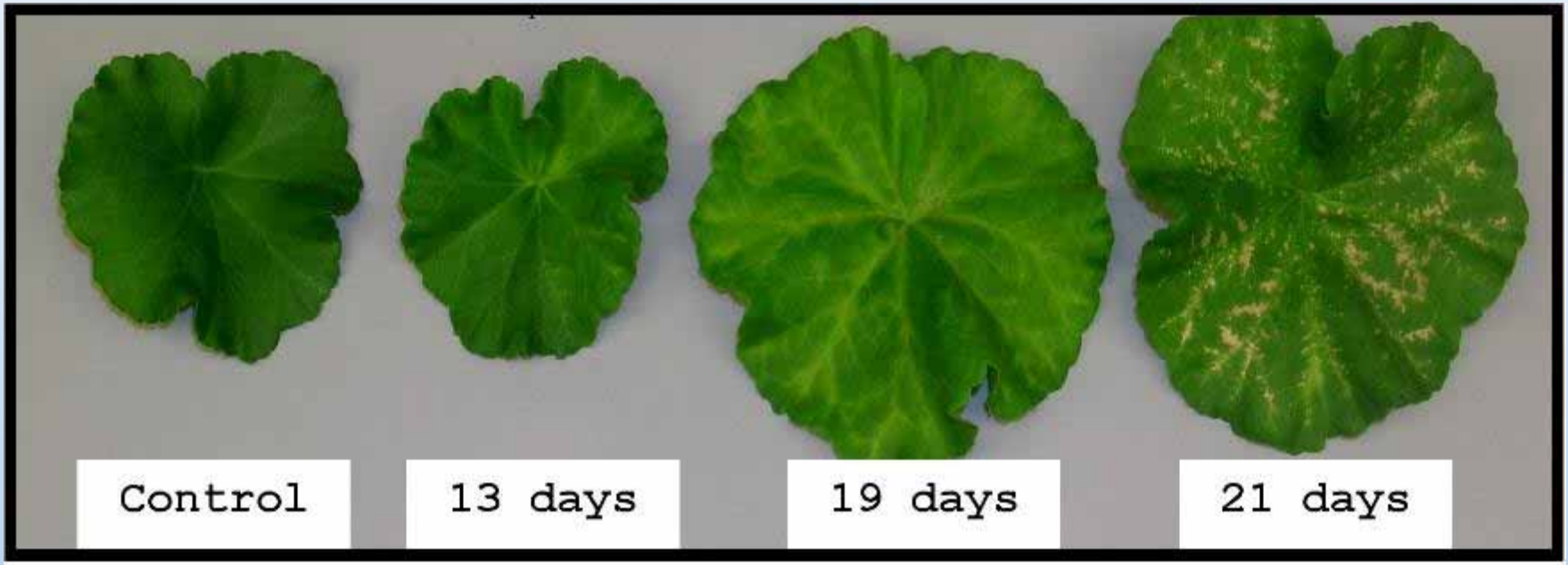
- **Zinc:**
  - Absorbed as Zn^{2+}.
  - Activates carboxylases enzyme.
  - Requires for synthesis of Auxins.
- **Copper:**
  - Absorbed as cupric ions (Cu^{2+}).
  - Essential for metabolism in plants.
  - Activation of enzymes.


-Zn

Figure 5. Plants with moderate (left) and severe (right) copper deficiency.

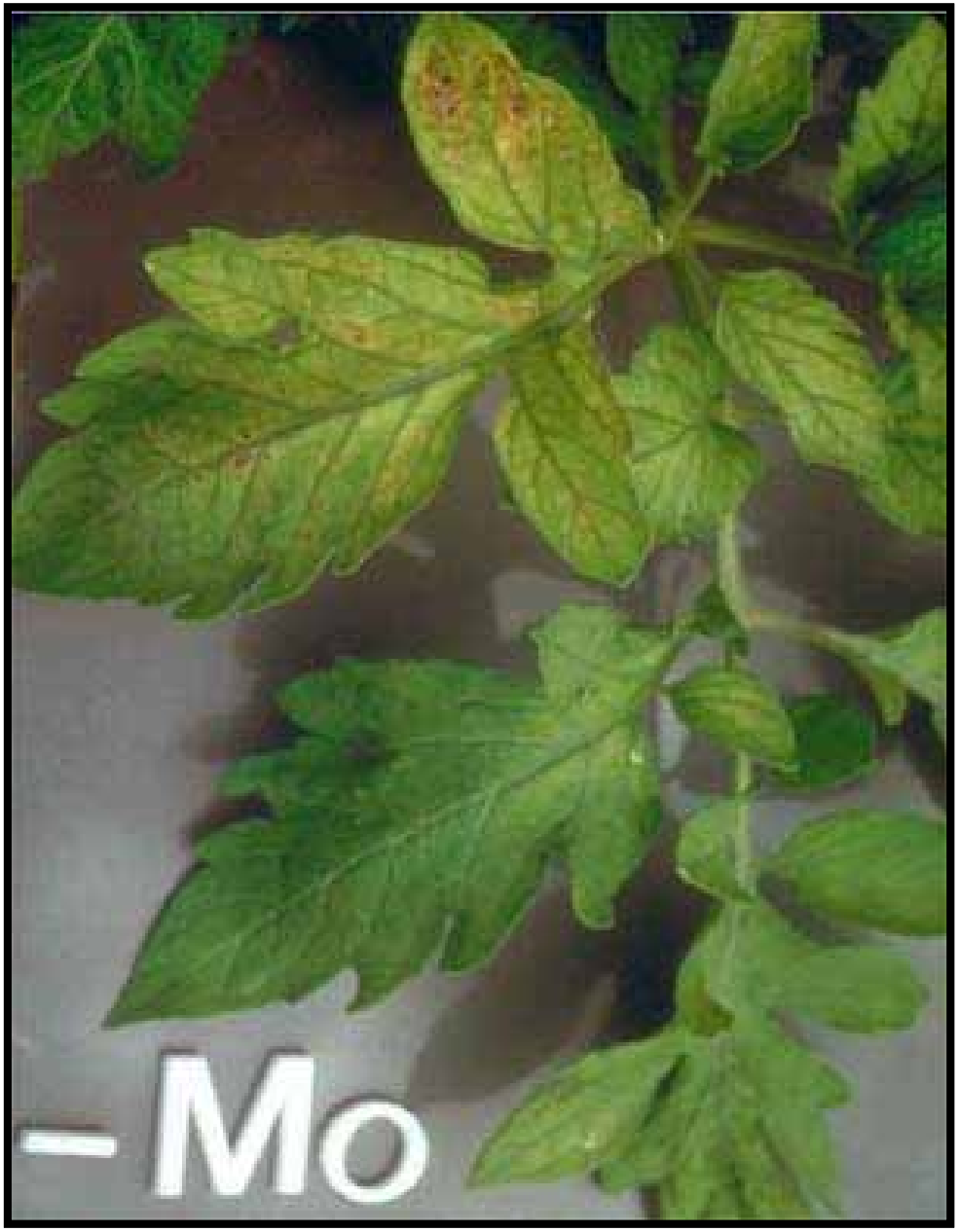
Boron:

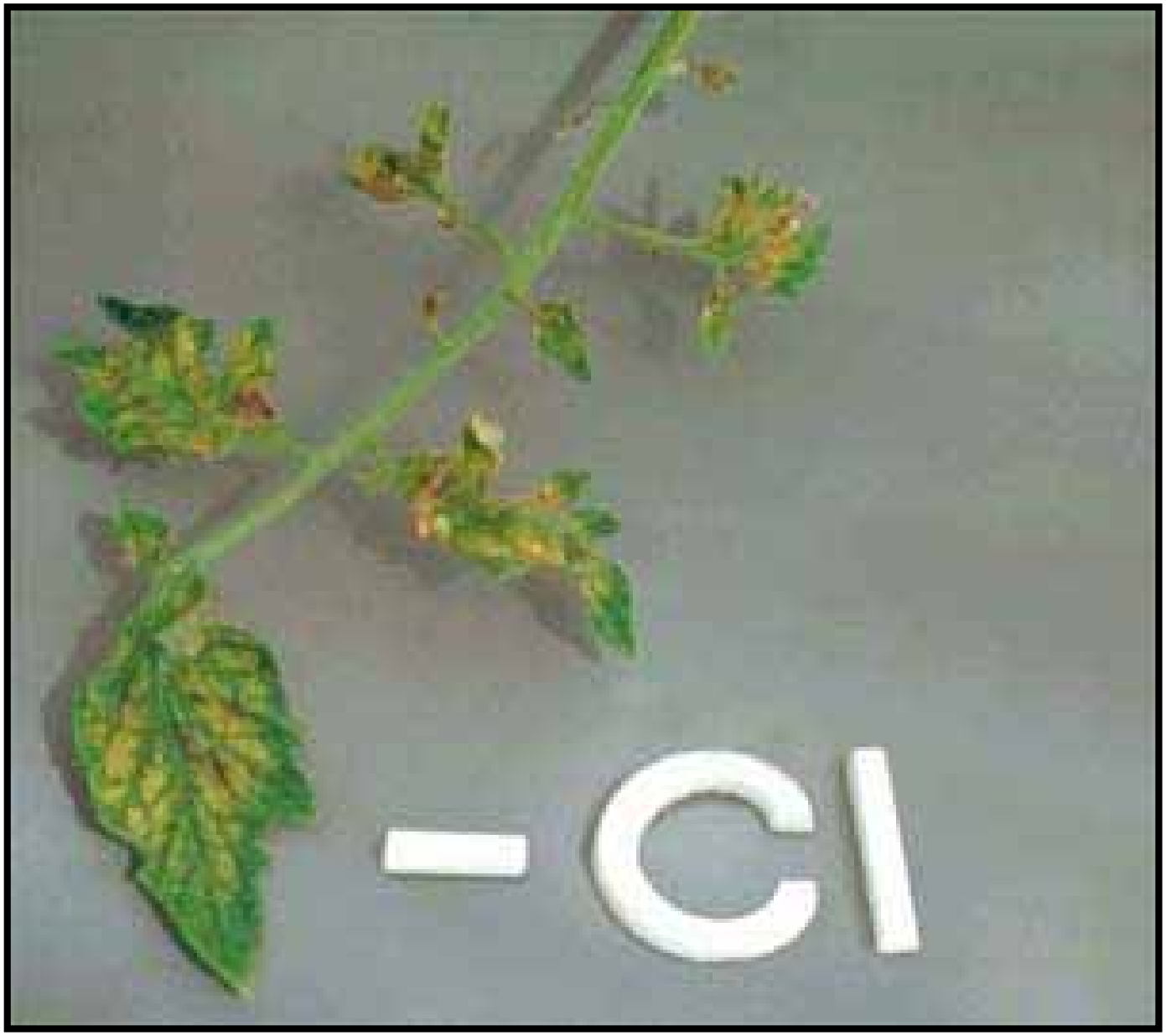
- Absorbed as BO_3^{3-} or $B_4O_7^{2-}$.
- Required for uptake and utilisation of Ca^{2+} , membrane functioning, pollen germination, cell elongation, cell differentiation and carbohydrate translocation.



+Boron **- Boron** **- Boron** **- Boron**

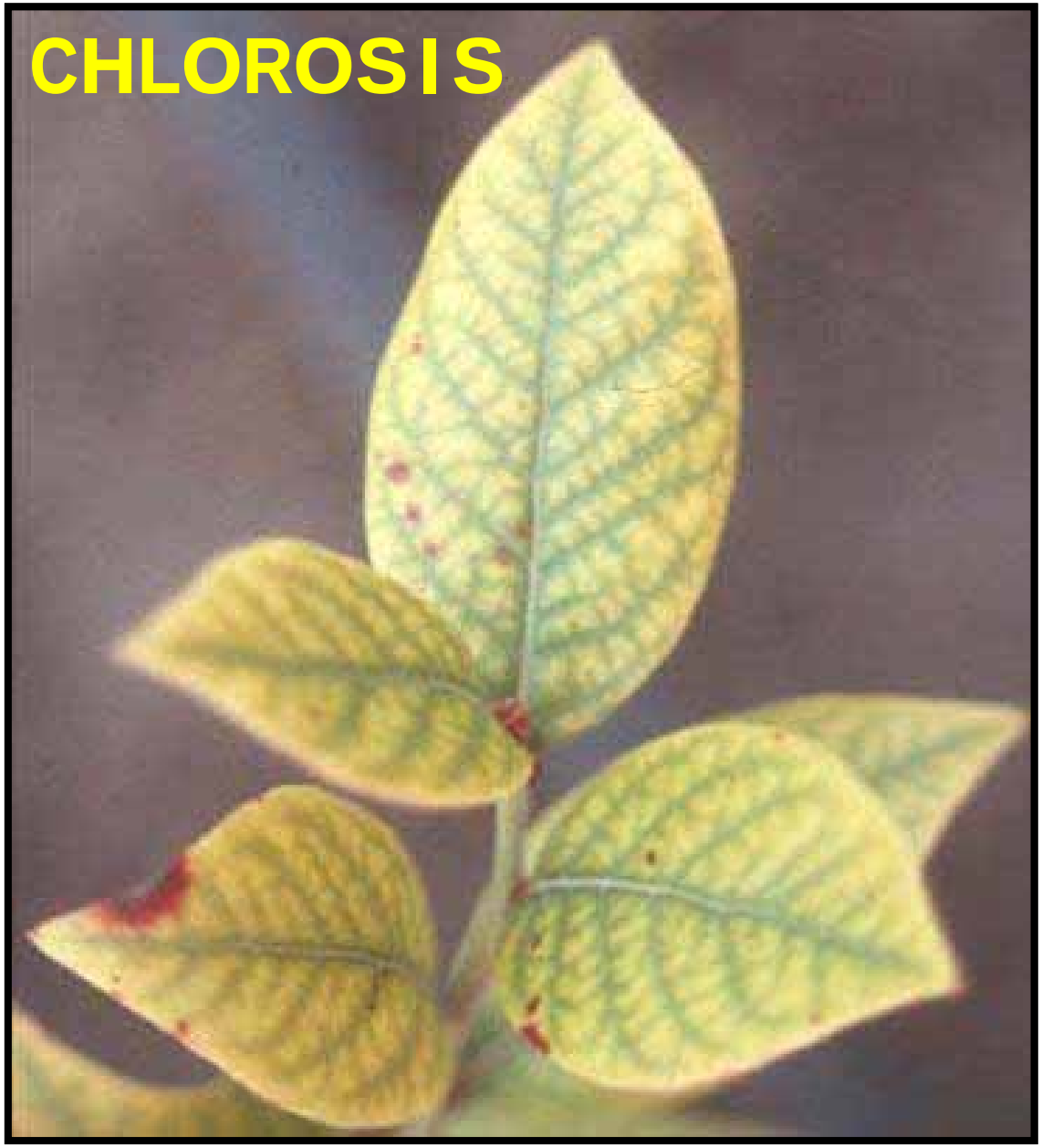
- **Molybdenum:**
  - Absorbed in the form of Molybdate ions (MoO_2^{2+}).
  - Components of enzymes like nitrogenase and nitrate reductase (Participates in nitrogen metabolism)
- **Chlorine:**
  - Absorbed in the form of Cl^-.
  - Helps in maintaining anion- cation balance.
  - Essential for water splitting reaction in photosynthesis.


– Mo


-Cl

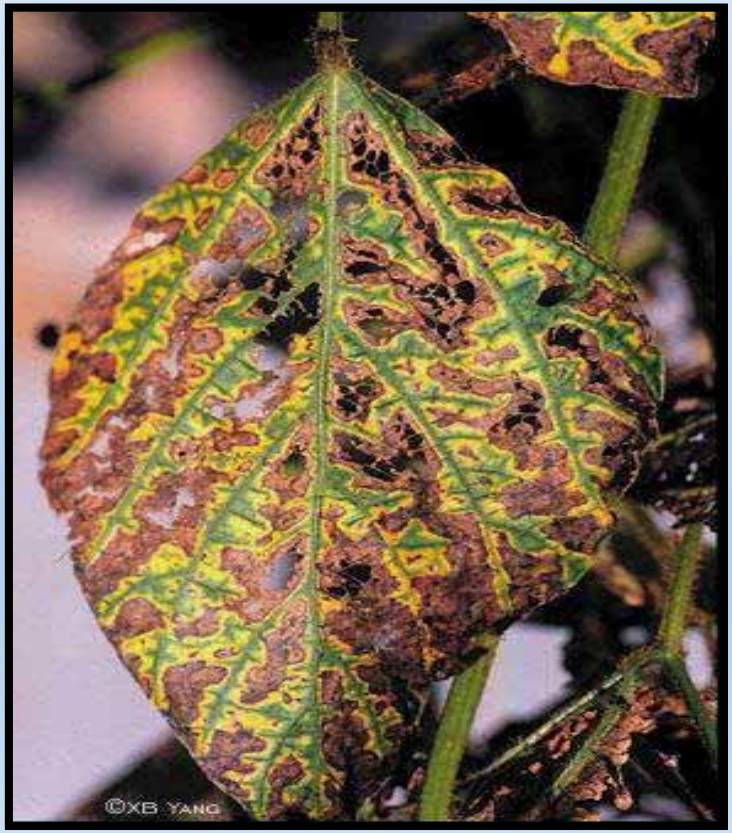
Deficiency symptoms of essenAtial elements:

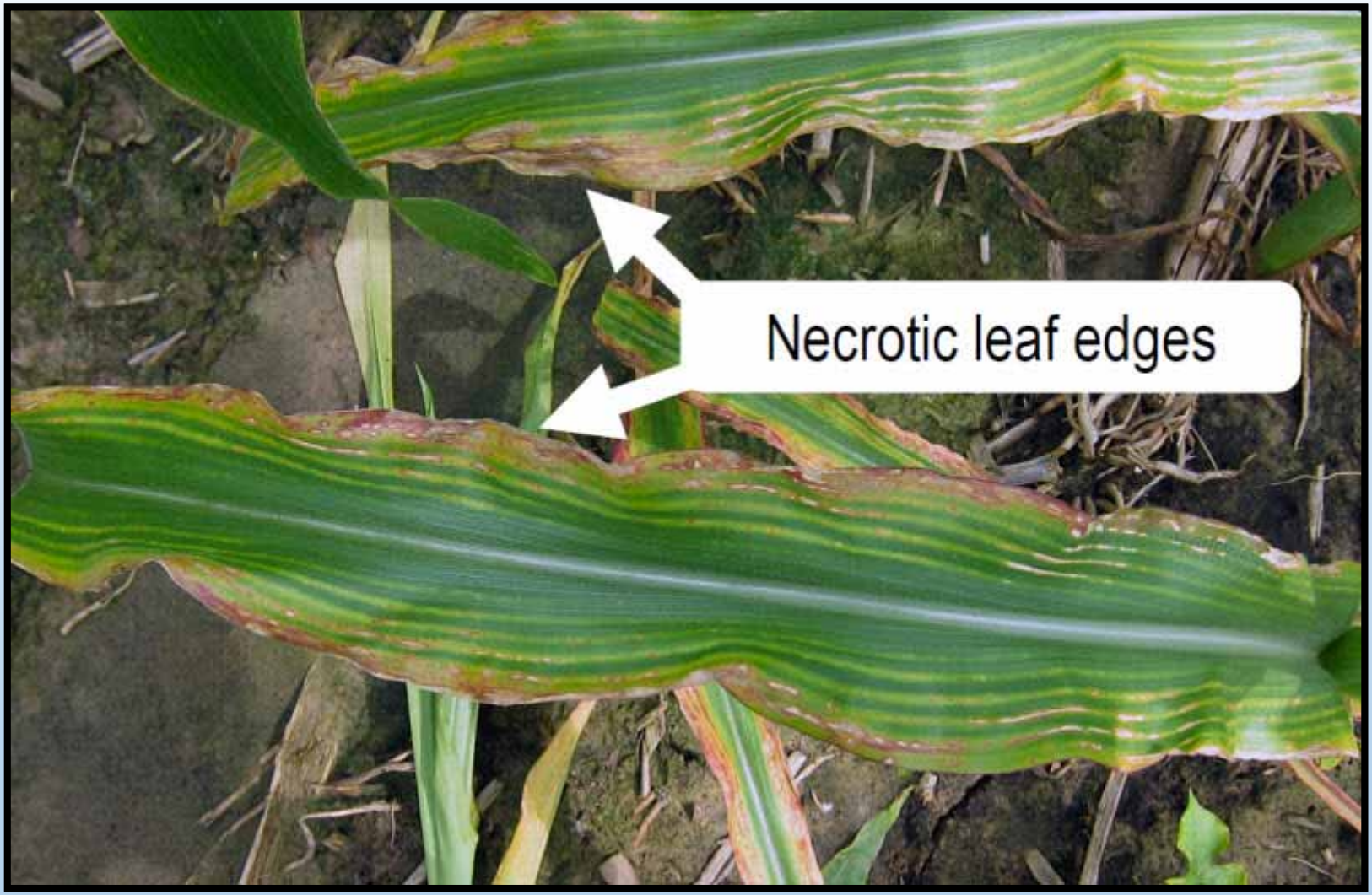
- **Chlorosis:**
  - Loss of chlorophyll leading to yellowing of leaf.
  - The deficiency of elements: N, K, Mg, S, Fe, Mn, Zn and Mo.


CHLOROSIS

Necrosis:

- Death of leaf tissue.
- Caused due to deficiency of Ca, Mg, Cu and K.




Necrotic leaf edges

- **Stunted growth and premature fall of leaves and buds:**
  - Deficiency of N, K, Mg, S, Fe, Mn, Zn and Mo
- **Inhibition of cell division:**
  - Deficiency of N, K, S, Mo.
- **Delay flowering:**
  - Deficiency of N, S, Mo.

Hydroponic Nutrient

Tips **Managing the Quality of Hydroponic Nutrition**

- Water quality - salinity, concentration of harmful elements dissolved in water (such as sodium, chloride and boron);
- The nutrients needed and their concentration in hydroponic nutrient solutions;
- Nutritional balance;
- The pH of the hydroponic nutrient solution and its effect on nutrient uptake by plants.

Hydroponic Nutrient

Tips

To use in the circulation system

- Periodically check the pH and EC of the nutrient solution
- The volume of the nutrient solution is adjusted to the number of plants
- The volume of nutrient solution must be maintained from the beginning of planting until harvest
- The water discharge is between 1-2 liters / minute and the slope of the gutter is between 3-5% (NFT)

To use of non-circulating systems

Nutrient solution is splashed into the substrate and stop before water drips out from the bottom of the pot

Hydroponic Nutrients

AB MIX

Hydroponic Nutrient

Stock A

$Ca(NO_3)_2$

KNO_3

Fe- EDTA

Hydroponic Nutrients

Sediment

$CaSO_4$ & $Ca_3(PO_4)_2$

Stock B

KH_2PO_4

$(NH_4)SO_4$

$MgSO_4$

$MnSO_4$

$CuSO_4$

$ZnSO_4$

H_3BO_3

Hydroponic Nutrient

Making the hydroponic nutrients

1

Find out the nutrient tolerant range

?

2

Determine what plant needs:

- Plants types & variety
- The part that is utilized
- Plant age
- Antagonistic properties among the nutrients

3

Calculating the nutrient composition

Hydroponic Nutrient

Nutrient tolerate range

Nutrient elements	ppm
NITROGEN (N, 14)	140 – 300
PHOSPOROUS (P, 31)	31 – 80
POTASSIUM (K, 39)	160 – 400
CALCIUM (Ca, 40)	100 – 200
MAGNESIUM (Mg, 24)	24 – 75
SULFUR (S, 32)	32 – 400
IRON (Fe, 56)	0,75 – 5
BORON (B, 11)	0,06 – 1
MANGANESE (Mn, 55)	0,11 – 2
ZINC (Zn, 65)	0,04 – 0,68
COPPER (Cu, 64)	0,02 – 0,75
MOLIBDENUM (Mo, 96)	0,001 – 0,04

Plant needs

Lettuce, mustard greens	Tomatoes
250	250
80	60
300	350
160	170
80	50
125	65
1,0	12
0,5	2,0
0,5	0,1
0,25	0,3
0,18	0,1
0,01	0,2

Hydroponic Nutrient

Calculating the amount of compounds

$5Ca(NO_3)_2.NH_4.NO_3.10H_2O$

Ca = 18,5 %

NO_3 = 14,2 %

NH_4 = 1,3 %

Ca → 185 ppm

→ 185 g/1.000 L x 100/18,5 = **1.000 g**

The amount of NO_3 and NH_4 :

NO_3 = 14,2 % x 1000 = 142 g/1.000 L

NH_4 = 1,3 % x 1000 = 13 g/1.000 L

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13			185		

Hydroponic Nutrient

$MgSO_4.7H_2O$

Mg = 9,7 %

S = 13 %

Mg → 62 ppm

→ 62 g/1.000 L x 100/9,7 = **639 g**

The amount of S :

S = 13 % x 639 = 83 g/1.000 L

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13			185	62	83

Hydroponic Nutrient

The amount K_2SO_4 → 27 g/1.000 L x 100/18,4 = **147 g**

S = 18,4 %

K = 44,8 %

S → 27 ppm

The amounts of K :

K = 44,8 % x 147 = 66 g/1.000 L

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13		66	185	62	83+27

NUTRISI HIDROPONIK

The amount of **KNO_3** → 80 g/1.000 L x 100/14 = **571 g**

NO_3 = 14 %

K = 39 %

NO_3 → 80 ppm

Maka jumlah K adalah

K = 39 % x 571 = 223 g/1.000 L

Unsur Hara	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Jumlah	142+13+80		66+223	185	62	83+27

Hydroponic Nutrient

The amount of

$NH_4.H_2.PO_4$

NH_4 = 12 %

P = 27 %

NH_4 15 ppm

15 g/1.000 L x 100/12 = **125 g**

The amount of P :

P = 27 % x 125 = 34 g/1.000 L

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13+80+15	34	66+223	185	62	83+27

Hydroponic Nutrient

Amount KH_2PO_4 → 28 g/1.000 L x 100/22,8 = **123 g**

P = 22,8 %

K = 28,7 %

P → 28 ppm

The Amount of K :

K = 28,7 % x 123 = 35 g/1.000 L

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13+80+15	34+28	66+223+35	185	62	83+27

Hydroponic Nutrient

Complete micronutrients pack

Fe : 1,3 ppm
Mn : 0,68 ppm
Cu : 0,68 ppm
Bo : 0,35 ppm
Zn : 0,28 ppm
Mo : 0,03 ppm

The amounts of micronutrients is **40 g/1.000 L**

Nutrient	N	P	K	Ca	Mg	S
g/1.000L	250	62	300	185	62	110
Sum	142+13+80+15	34+28	66+223+35	185	62	83+27

Hydroponic Nutrient

Stock	Compound	Amounts g/1.000 L
A	$5Ca(NO_3)_2.NH_4.NO_3.10H_2O$	1000
B	$MgSO_4.7H_2O$	639
B	K_2SO_4	147
A or B	KNO_3	571
B	$NH_4.H_2.PO_4$	125
B	KH_2PO_4	123
A	Complete Micro Element	40

Diluted into 1000 liters of solution

Hydroponic Nutrient

Dosage

Dissolved into 5 liters of solution per stock

Stock A 5 Liter
Stock B 5 Liter

200 X

1000 L

Example:
If we need 600 liters of solution, the stock needed is :
600 Liter / 200 = 3 L of Stok A and 3 L of Stok B


THANK YOU
HYDROPONIC FARMING

Macro elements	Atomic weight
Nitrogen (N)	14.01 (14)
Phosphorus (P)	30.97 (31)
Potassium (K)	39.10 (39)
Calcium (Ca)	40.08 (40)
Magnesium (Mg)	24.31 (24)
Sulphur (S)	32.06 (32)
Oxygen (O)	16.00 (16)
Carbon (C)	12.01 (12)
Hydrogen (H)	1.008 (1)
Micro elements	**Atomic weight**
Iron (Fe)	55.85 (56)
Boron (B)	10.81 (11)
Manganese (Mn)	54.94 (55)
Zinc (Zn)	65.37 (65)
Copper (Cu)	63.54 (64)
Molybdenum (Mo)	95.94 (96)
Chlorine (Cl)	35.45 (35)
Sodium (Na)	22.99 (23)

Macro and micro element atomic weight which is used in the calculation of hydroponic fertilizer requirements


UREA
PUPUK UREA

N = 46%


Grow More


KALIUM KLORIDA
KCL
(MURIATE OF POTASH)

K = 60%


Gandasil-B
Gandasil
SNI
SNI


PUPUK SUPER FOSFAT
SP-36

P = 36%


Hydroponics for Kids


min order 10 bks bisa campur = 4.000/bks


ONLY 3.000 IDR












Simple Hydroponics