

Hydroponic Nutrients



AGENCY FOR AGRICULTURE EXTENSION
AND HUMAN RESOURCES DEVELOPMENT
AGRICULTURE MINISTRY

**Professional
Competitiveness
Entrepreneurship**

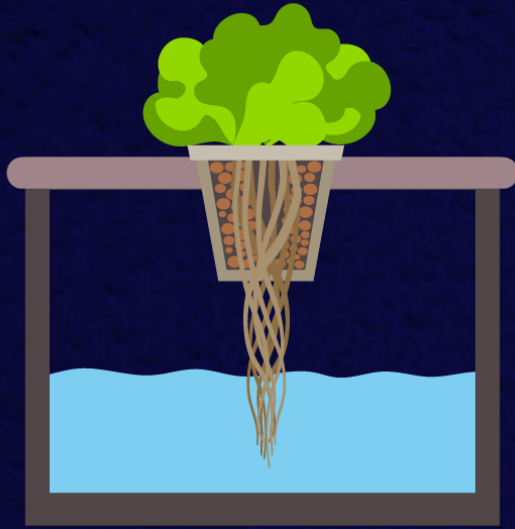


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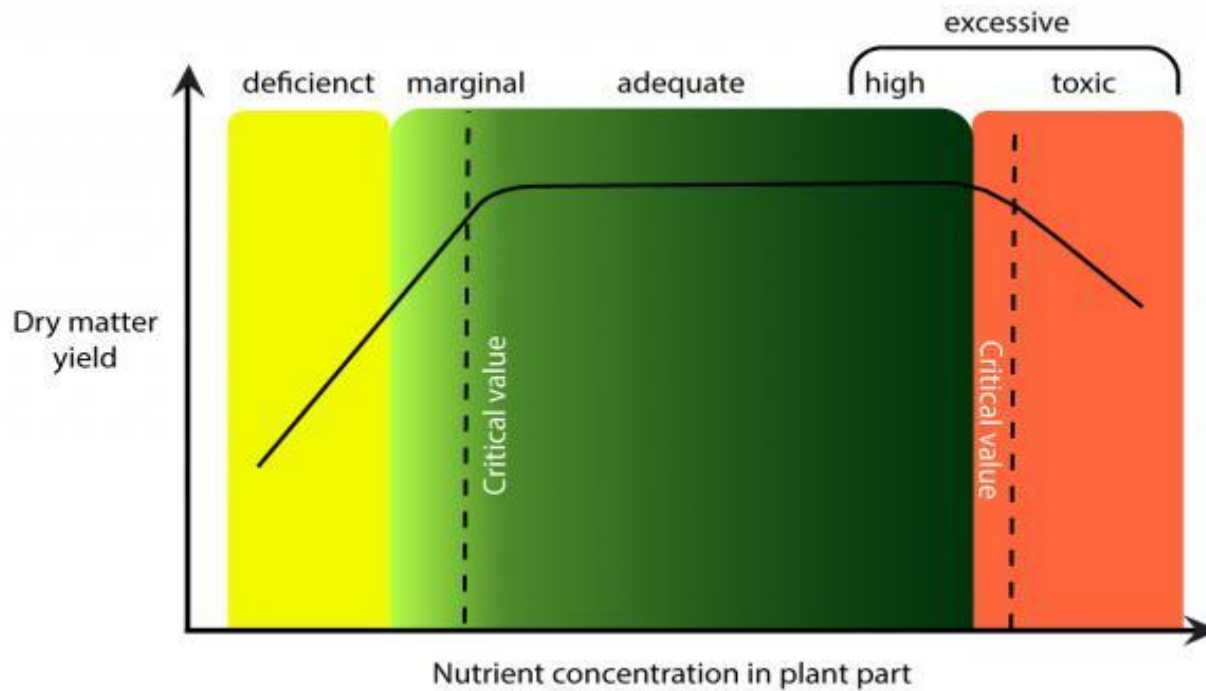
Objectives

- Participants will be able to understand the importance of hydroponic nutrients
- Participants are able to prepare the hydroponic nutrients





Nutrient solution to Hydroponic is
just like fertilizers to soil.



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

Water Quality



Water Sources

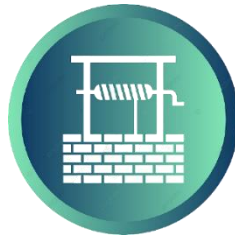
Tap water



Rain water



Underground water



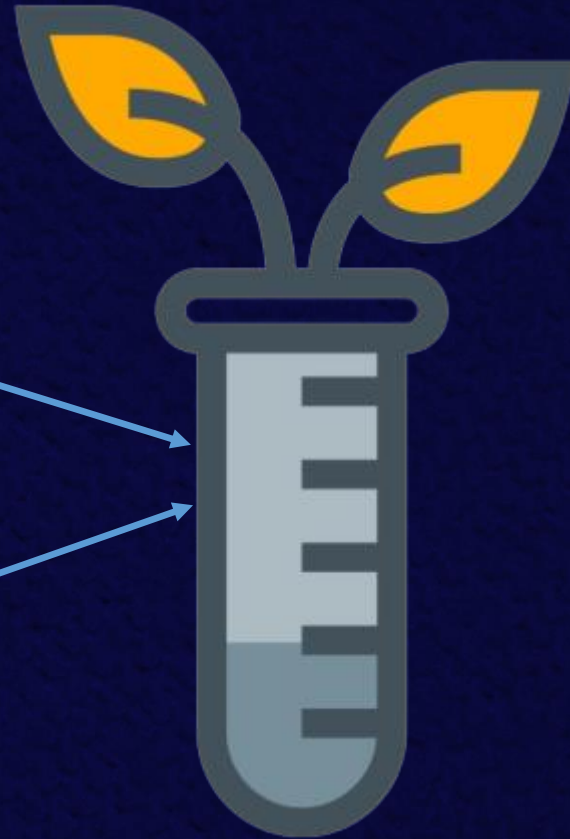
Surface water



Electrical Conductivity (EC)



pH



Plant Nutrients



To be classified as “essential”, the element needs to meet the following criteria:



The plant cannot complete its life cycle without it.



The elements' function cannot be replaced by another element



The element is directly involved in the plant's growth and reproduction.



Hydroponic Nutrient



Plant Nutrients

Macro Nutrient

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

C, H, O

Micro Nutrient

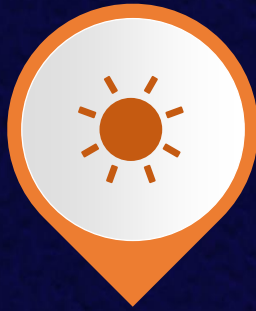
Iron (Fe)
Manganese (Mn)
Boron (Bo)
Zinc (Zn)
Chlorin (Cl)
Molybdenum (Mo)
Copper (Cu)

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



Biomolecules

Carbon, hydrogen, oxygen and nitrogen..



Energy

Magnesium in chlorophyll and phosphorus in ATP.



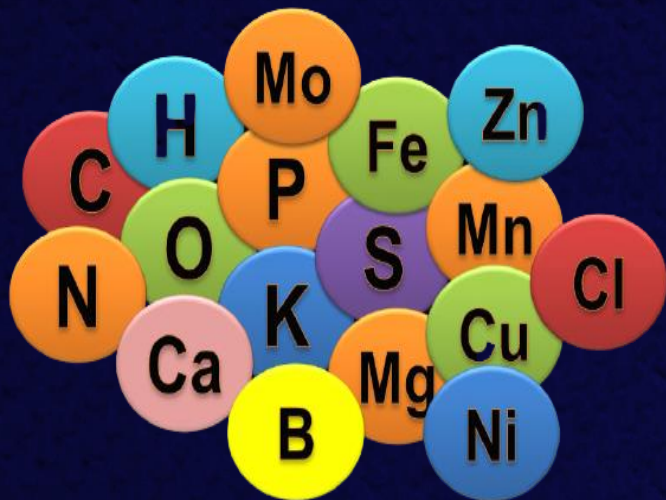
Enzymes

Mg ion and Zn ion.

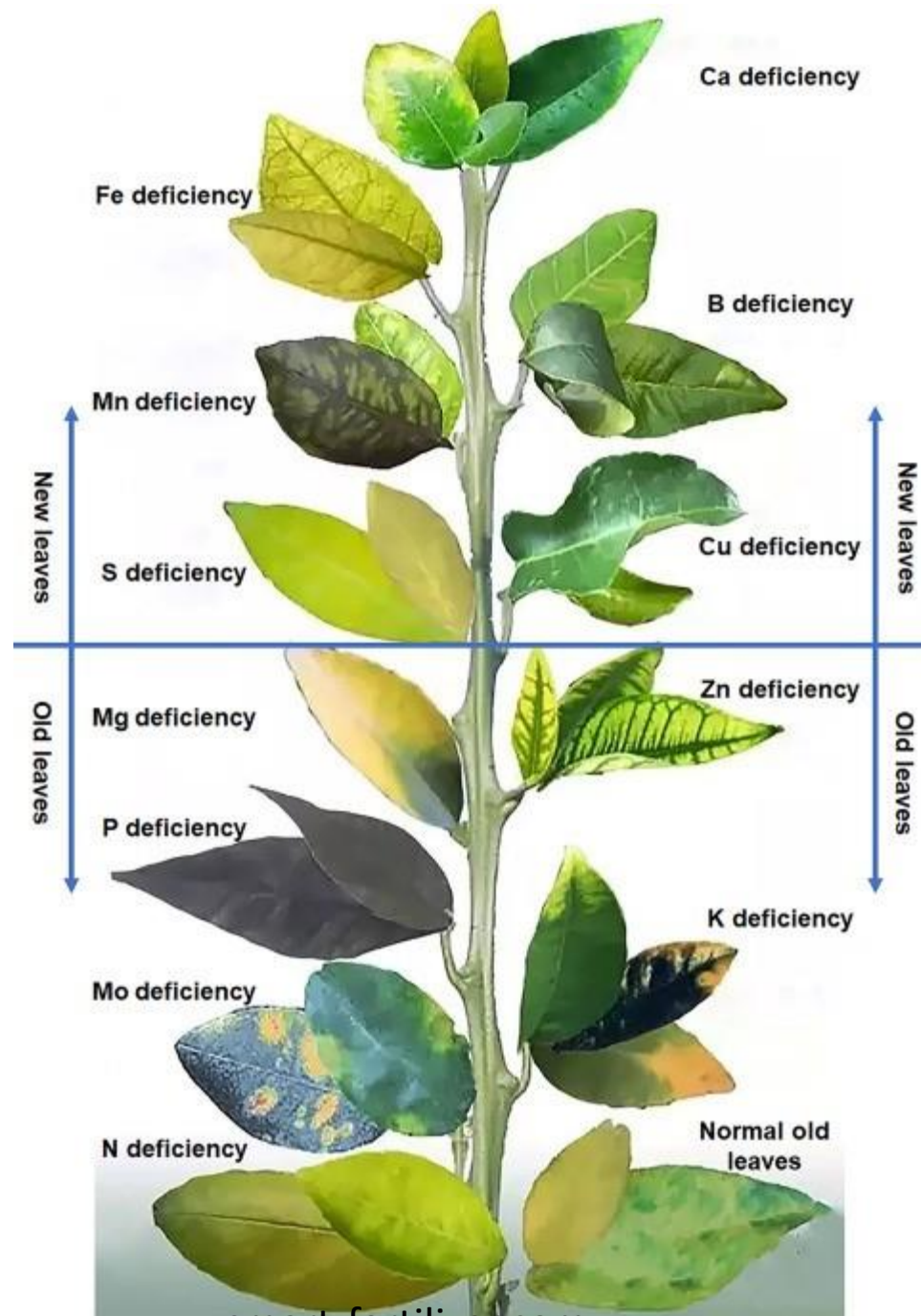


Osmotic Potential

Potassium. It plays an important role in opening and closing of stomata.



Element	Function in Plant
N	Responsible for vegetative growth and the building block of for protein in the plant
P	Critical in root development, crop maturity, and seed production.
K	Activates enzymes and important to a plants ability to withstand extreme temperatures and drought.
B	Important in sugar transport, cell division, and amino acid production.
Cl	Used in turgor regulation, resisting diseases, and photosynthesis reactions.
Cu	Component of enzymes, involved with photosynthesis.
Fe	Component of enzymes, essential for chlorophyll synthesis and photosynthesis.
Mo	Involved in nitrogen metabolism, essential in nitrogen fixation.
Mn	Chloroplast production, cofactor in many plant reactions, activates enzymes.
Zn	Component of many enzymes, essential for plant hormone balance and auxin activity.

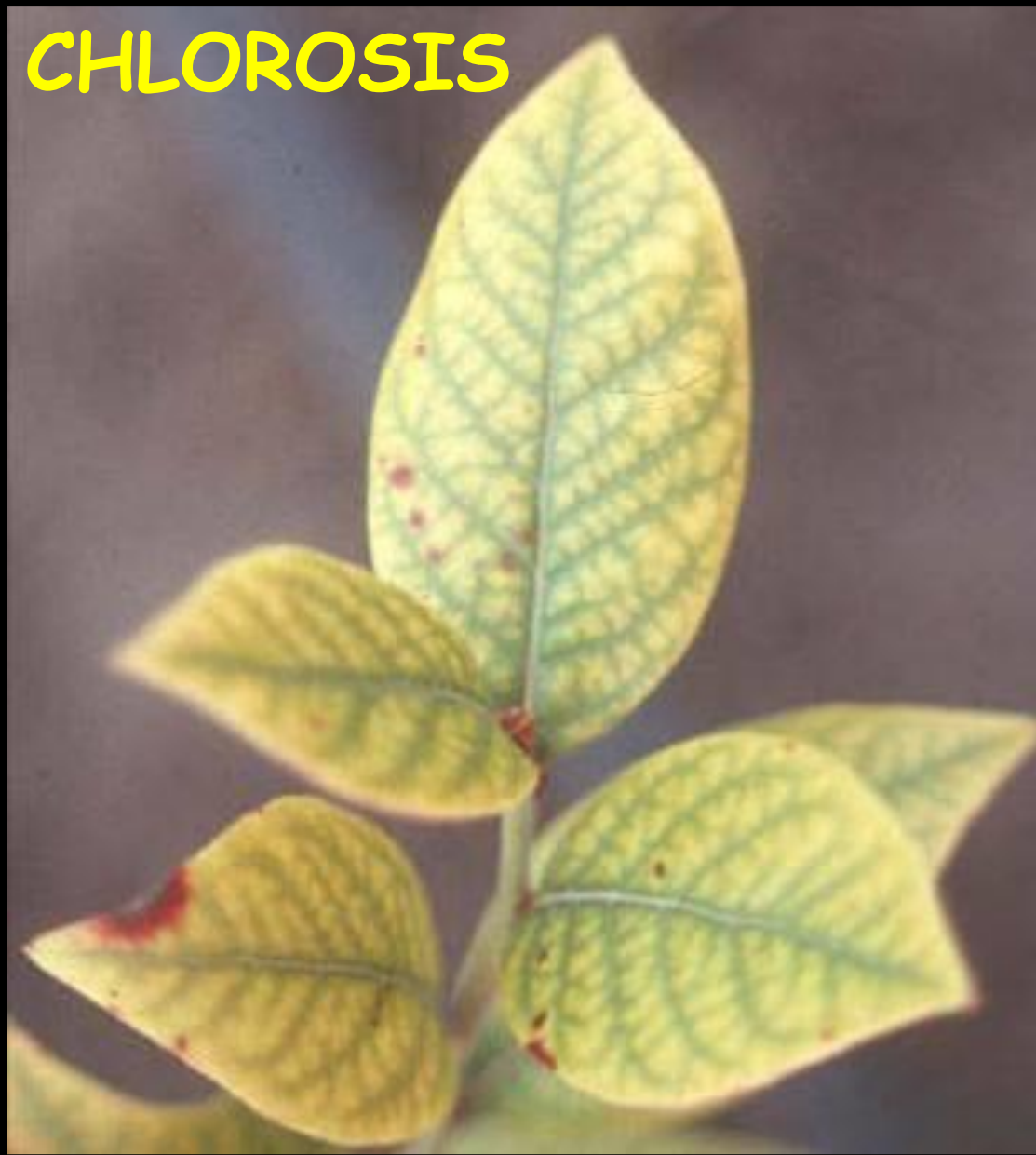


Deficiency symptoms of Essential elements:

□ Chlorosis:

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

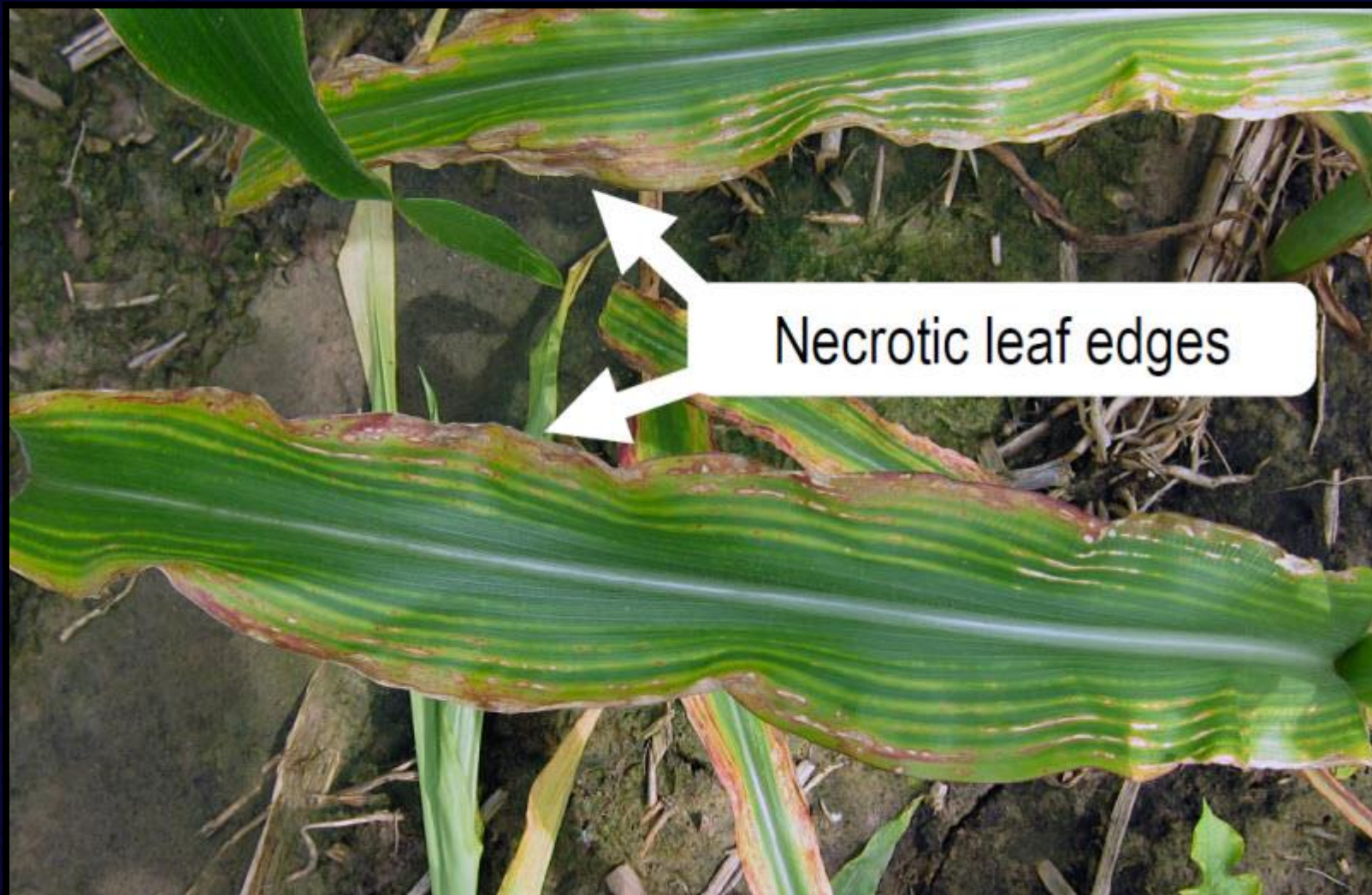
CHLOROSIS



❑ **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.



- N



- Fe



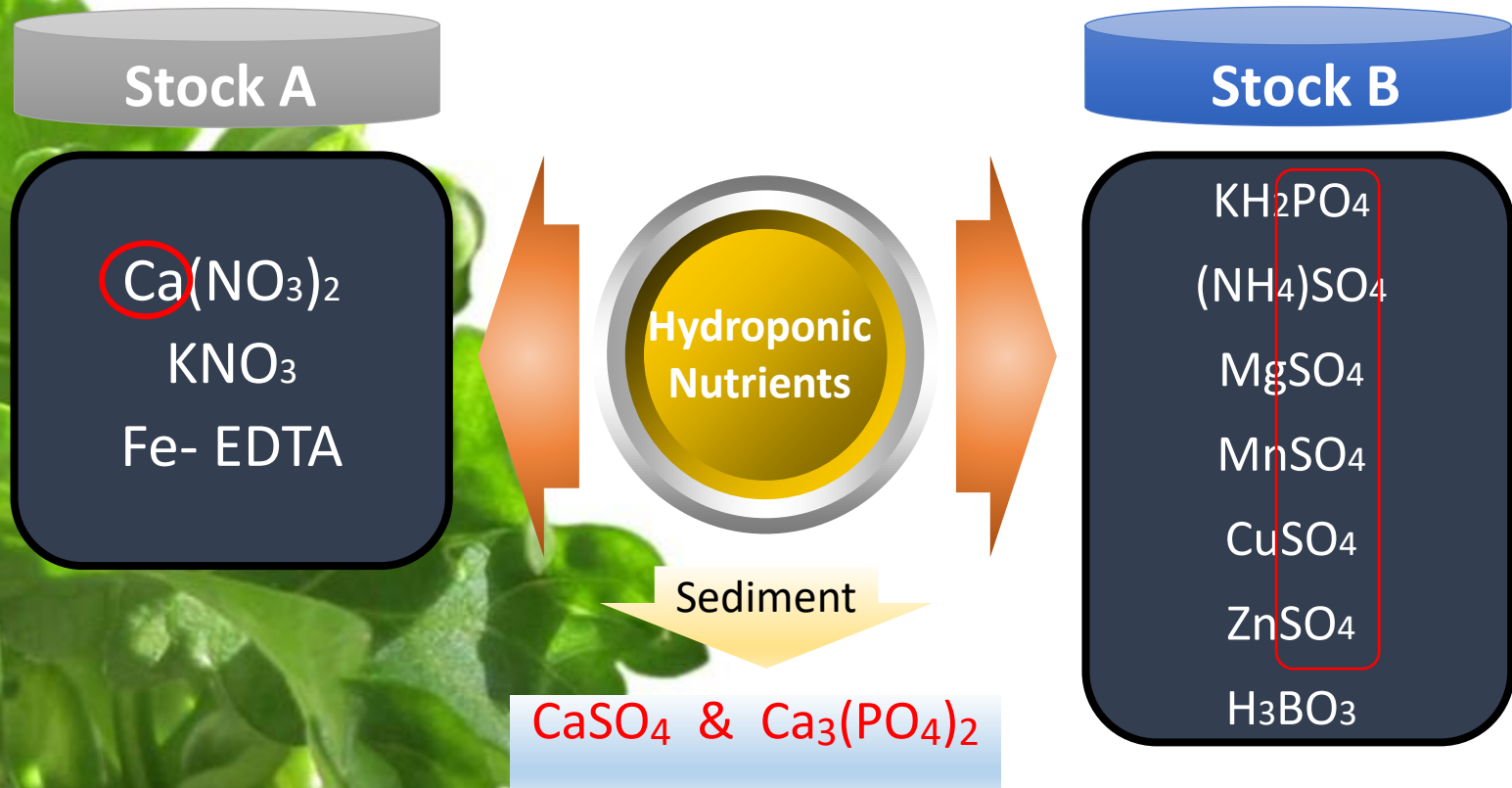
Hydroponic Nutrients



AB MIX



Hydroponic Nutrient



Hydroponic Nutrient

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





Nutrient	Antagonism with
Nitrogen	Potassium
Phosphorous	Zinc
Potassium	Nitrogen, Calcium, Magnesium
Sodium	Potassium, Calcium, Magnesium
Calcium	Magnesium, Boron
Magnesium	Calcium
Iron	Manganese

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



Ca = 18,5 %

NO₃ = 14,2 %

NH₄ = 1,3 %

Ca → 185 ppm

$$\longrightarrow 185 \text{ g/1.000 L} \times 100/18,5 = \mathbf{1.000 \text{ g}}$$



The amount of NO₃ and NH₄ :

$$\text{NO}_3 = 14,2 \% \times 1000 = 142 \text{ g/1.000 L}$$

$$\text{NH}_4 = 1,3 \% \times 1000 = \mathbf{13 \text{ g/1.000 L}}$$

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



Hydroponic Nutrient

$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ $\longrightarrow$ $62 \text{ g/1.000 L} \times 100/9,7 = 639 \text{ g}$

Mg = 9,7 %

S = 13 %

Mg $\longrightarrow$ 62 ppm



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 $\longrightarrow$ $27 \text{ g/1.000 L} \times 100/18,4 = \mathbf{147 \text{ g}}$

S = 18,4 %

K = 44,8 %

S $\longrightarrow$ $\mathbf{27 \text{ ppm}}$

The amounts of K :

K = 44,8 % $\times$ 147 = $\mathbf{66 \text{ g/1.000 L}}$

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



Hydroponic Nutrient

The amount of KNO_3 $\longrightarrow$ $80 \text{ g}/1.000 \text{ L} \times 100/14 = \mathbf{571 \text{ g}}$

$\text{NO}_3 = 14 \%$

$\text{K} = 39 \%$

$\text{NO}_3 \longrightarrow 80 \text{ ppm}$

The amount of potassium is

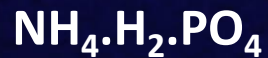
$\text{K} = 39 \% \times 571 = \mathbf{223 \text{ g}/1.000 \text{ L}}$

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



Hydroponic Nutrient

The amount of



$$\text{NH}_4 = 12 \%$$

$$\text{P} = 27 \%$$

$$\text{NH}_4 \longrightarrow 15 \text{ ppm}$$



$$15 \text{ g/1.000 L} \times 100/12 = 125 \text{ g}$$



The amount of P :

$$\text{P} = 27 \% \times 125 = 34 \text{ g/1.000 L}$$

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
P = 22,8 %
K = 28,7 %
P → 28 ppm



$$28 \text{ g/1.000 L} \times 100/22,8 = \mathbf{123 \text{ g}}$$



The Amount of K :

$$\text{K} = 28,7 \% \times 123 = \mathbf{35 \text{ g/1.000 L}}$$

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	$5\text{Ca}(\text{NO}_3)_2 \cdot \text{NH}_4 \cdot \text{NO}_3 \cdot 10\text{H}_2\text{O}$	1000
B	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	639
B	K_2SO_4	147
A or B	KNO_3	571
B	$\text{NH}_4 \cdot \text{H}_2 \cdot \text{PO}_4$	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:

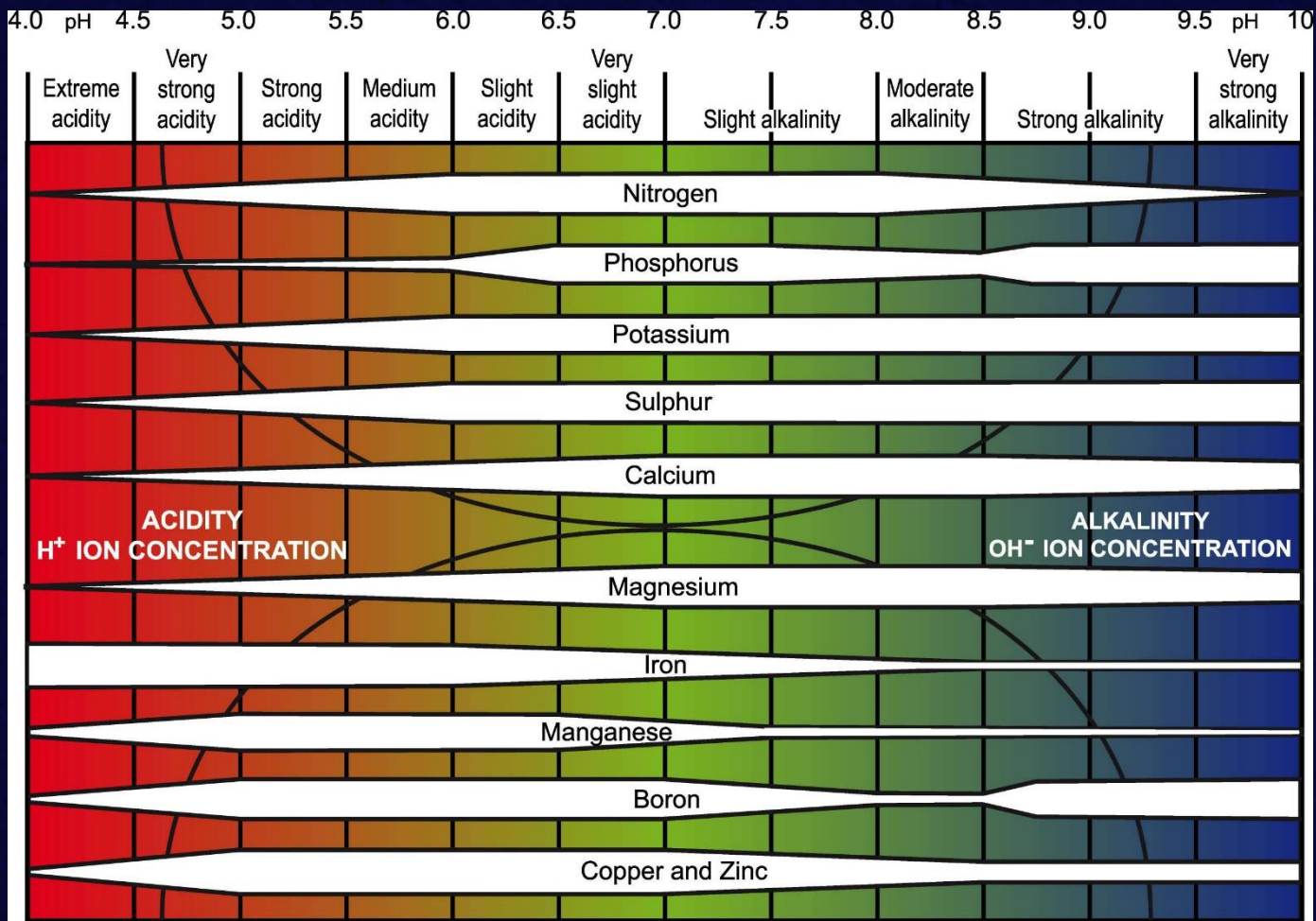
If we need 600 liters of solution, the stock needed is :

$600 \text{ Liter} / 200 = 3 \text{ L of Stok A and } 3 \text{ L of Stok B}$

Example : composition formula of commercial hydroponic nutrient

Elements	Leafy vegetable (lettuce, spinach, kale, mustard)	Fruit (Tomato, eggplant, paprika, pepper, cucumber, melon)	Ornamental plant (Broccoli, Adenium, Orchid, Cauliflower)	Tuber (shallot, potato, carrot, radish)
	(%)	(%)	(%)	(%)
N	20.7	17.9	18.6	18.6
Ca	14.5	14.3	12.9	13
K	24.8	28.1	30.4	28.8
Mg	5.1	5.6	5.1	5.6
S	8.9	9.5	7.7	9.6
P	5.1	6.5	6.8	5.6
Fe	0.10	0.09	0.09	0.09
Mn	0.05	0.04	0.05	0.04
Cu	0.05	0.04	0.05	0.04
B	0.03	0.02	0.02	0.02
Zn	0.02	0.02	0.02	0.02
Mo	0.001	0.001	0.001	0.001





redrawn by PDA from Troug, E. (1946)

Hydroponic Nutrients from NPK

For 10 L of nutrient solution

- NPK (16-16-16) : 10 g (1 table spoon)
- KCl : 10 g (1 table spoon)
- Gandasil / green growmore (leaf fertilizer) : 5 g
- 10 L fresh water

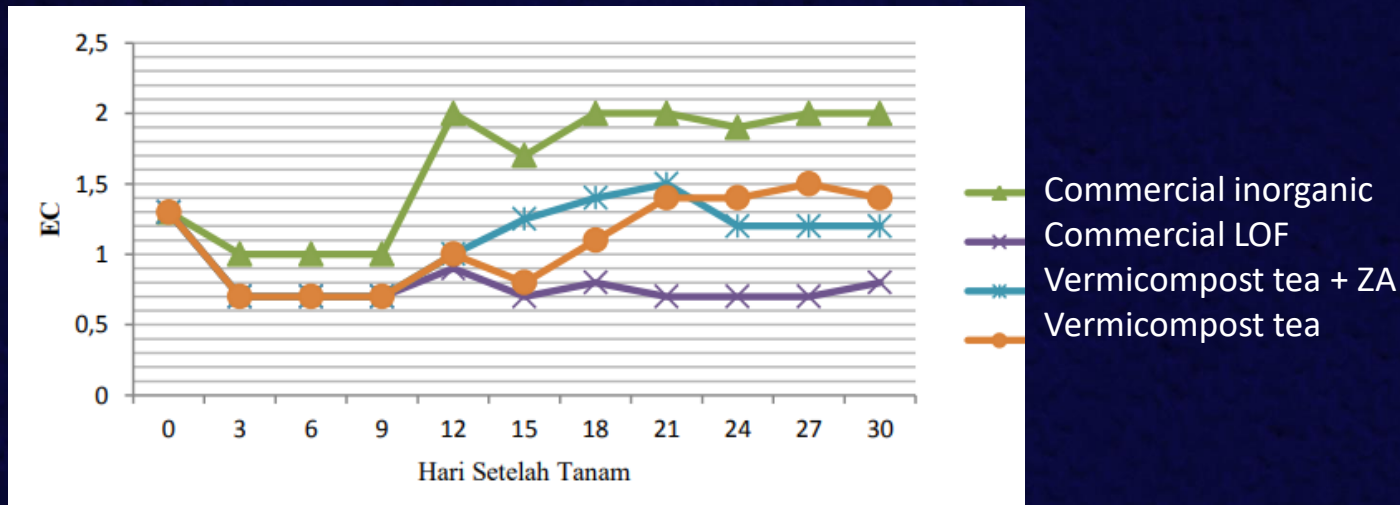


- NPK (16-16-16) : 15-30 g
- KCl : 10 g (1 table spoon)
- Gandasil D / red growmore (leaf fertilizer) : 5 g
- Urea : 15-20 g (vegetative) 7-10 g (generative)
- 10 L fresh water

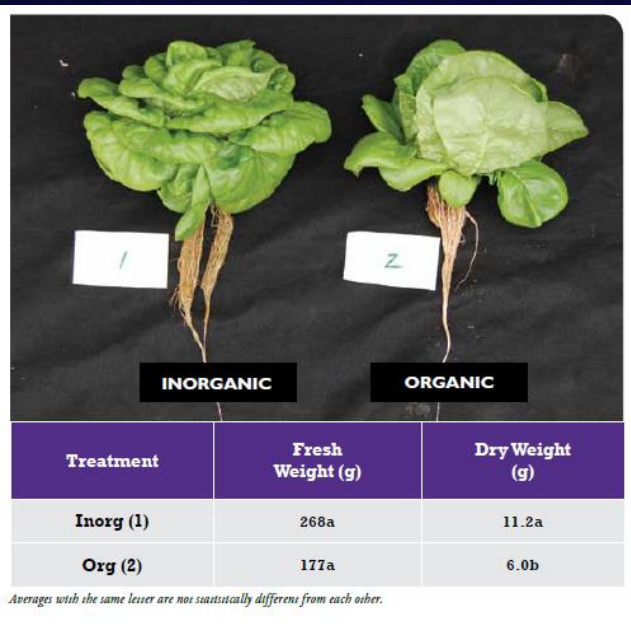


Organic hydroponics?





Tanjung et al. 2018



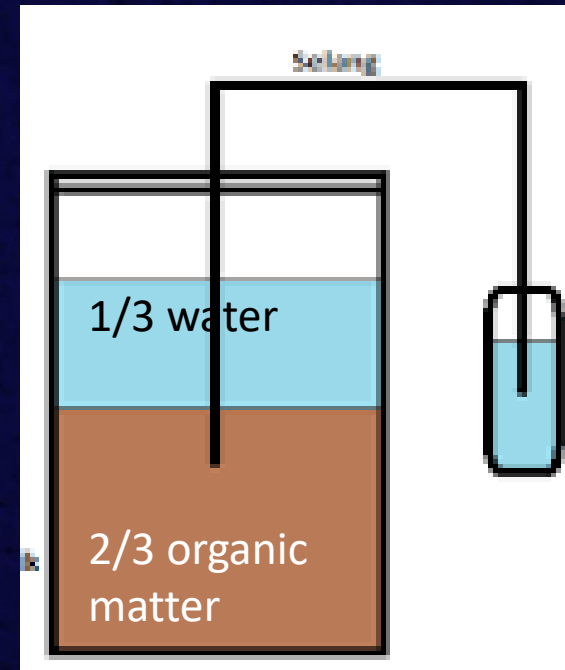
Williams et al. 2013

- Most Countries do not allow hydroponics to be labeled organic
- Nutrient content in organic fertilizers is uncertain (elements, pH, EC)



Liquid Organic Fertilizer

- 1 sacks of chicken/ goat manure (20 kg)
- ½ sacks of rice bran (10 kg)
- Rice straw or legume leaf (30 kg)
- Brown sugar 100 g
- Bio activator (EM1/ EM4) 50 ml
- 100 L capacity of bucket or container
- Aerator hose
- Water
- Mineral plastic bottle

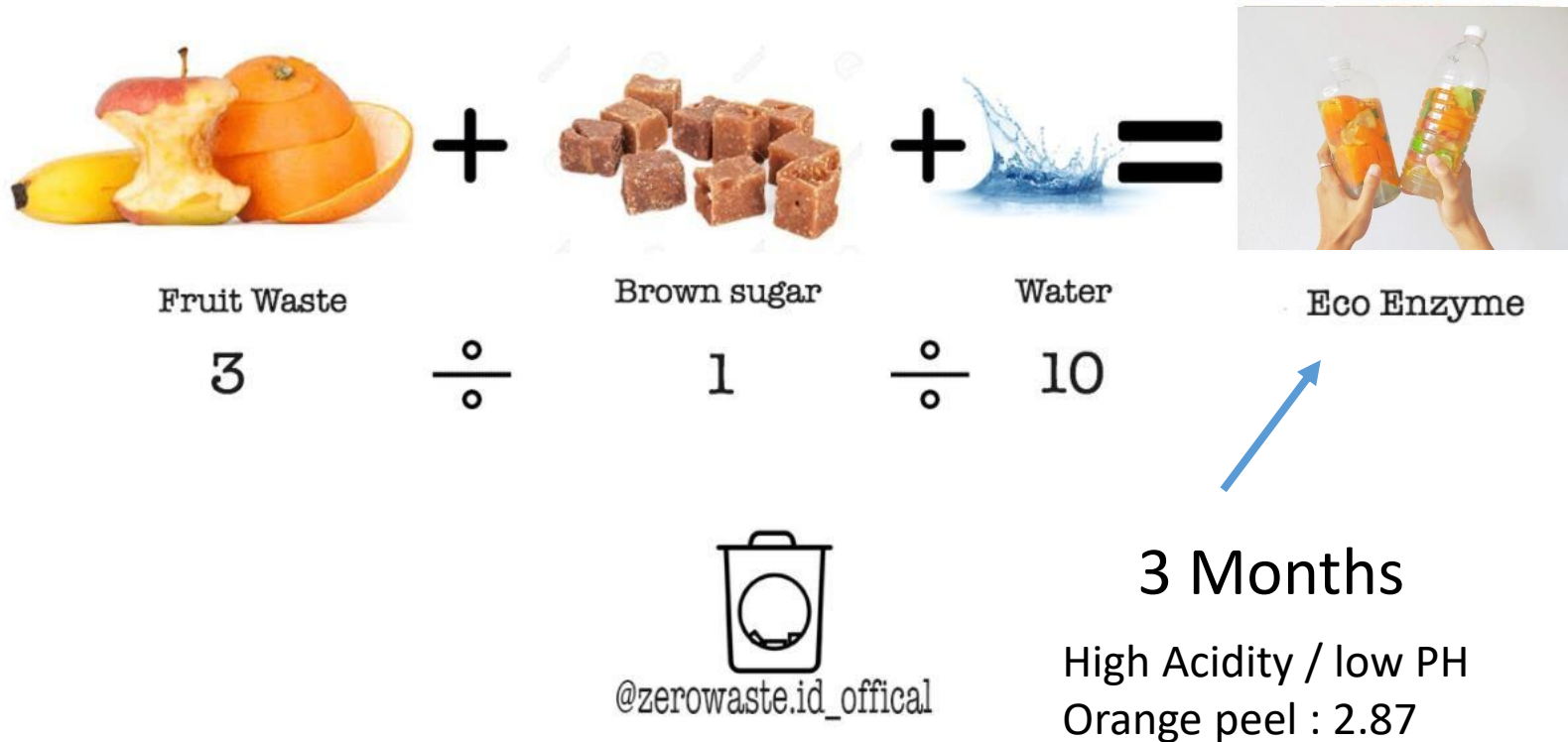


7-10 days

Filtered

1 L for 100 L solution

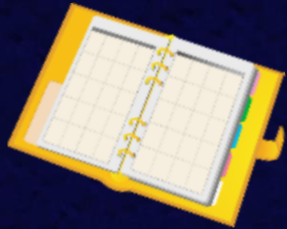
WHAT IS ECO ENZYME?



Diluted > 1000 times before use as fertilizer
Added to AB Mixed nutrients solution for hydroponics maintain
to 1200 ppm

Hydroponic Nutrient

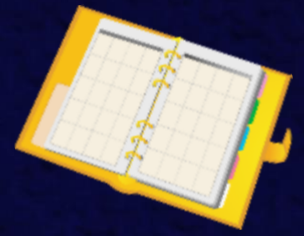
Managing the Quality of Hydroponic Nutrition



Tips

- 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

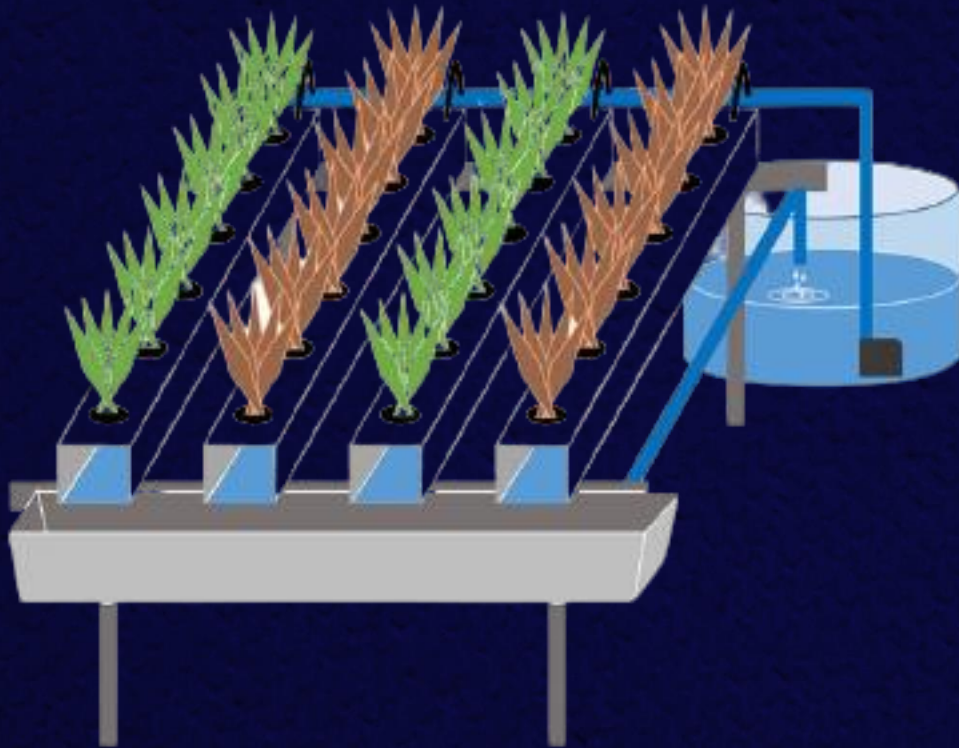
To use in the circulation system

- 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)

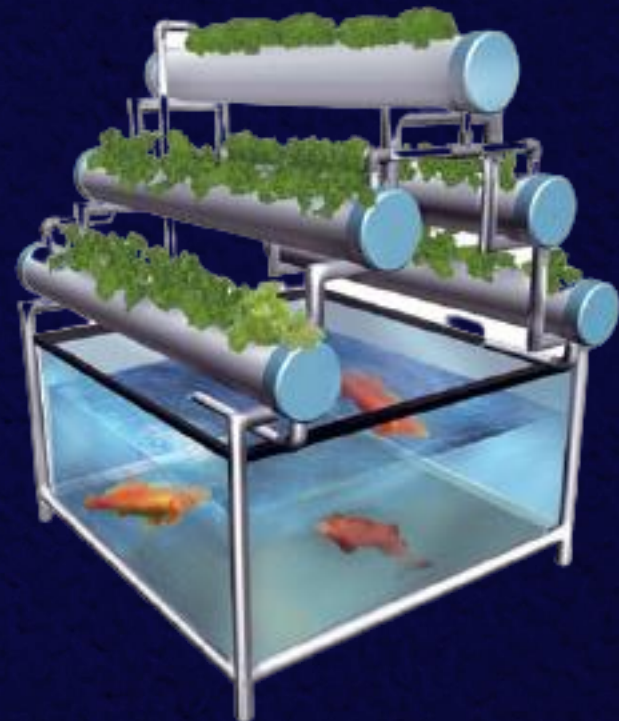
To use of non-circulating systems

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

Hydroponics



Aquaponic



Hydroponic nutrient in Aquaponic

- Water from fish pond (Tilapia fish) used in Aquaponics, Basil and lettuce yield reduced 56 and 67% from hydroponic (Yang and Kim 2020)
- Nutrient from aquaculture sludge similar with conventional nutrient (Ezziddine *et al* 2021)





Aquaponic in the bucket
(catfish and kangkong)



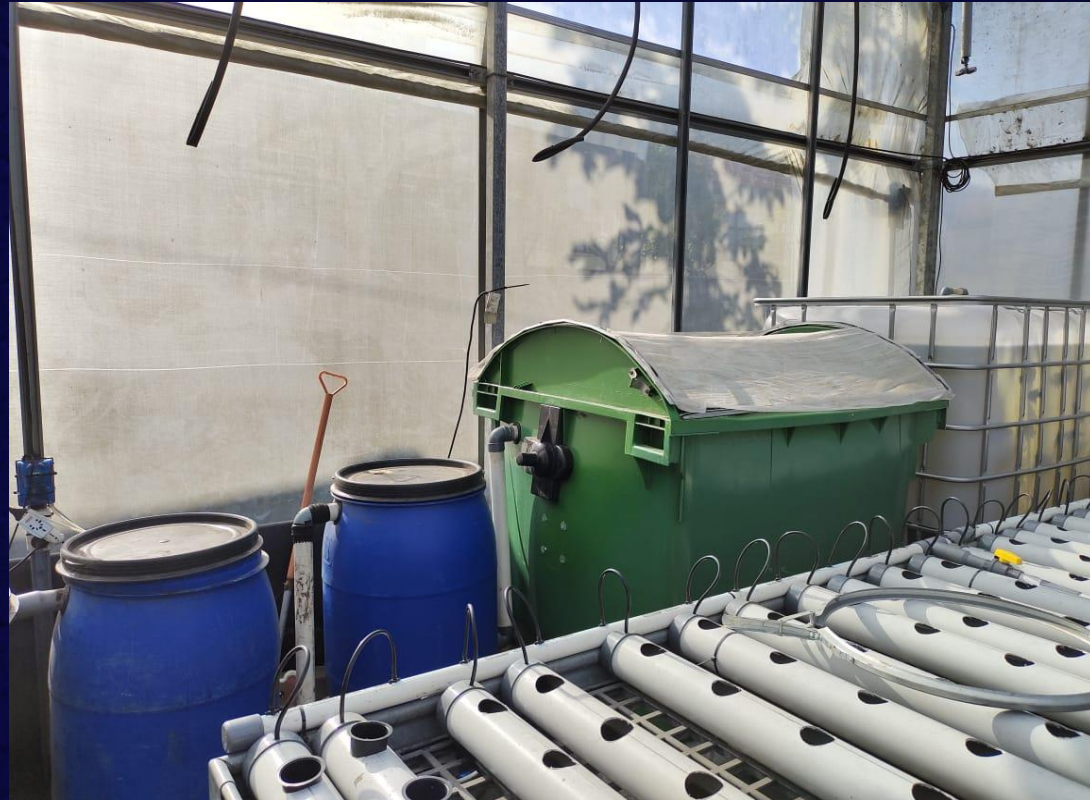
Simple aquaponic (tilapia and
celery)

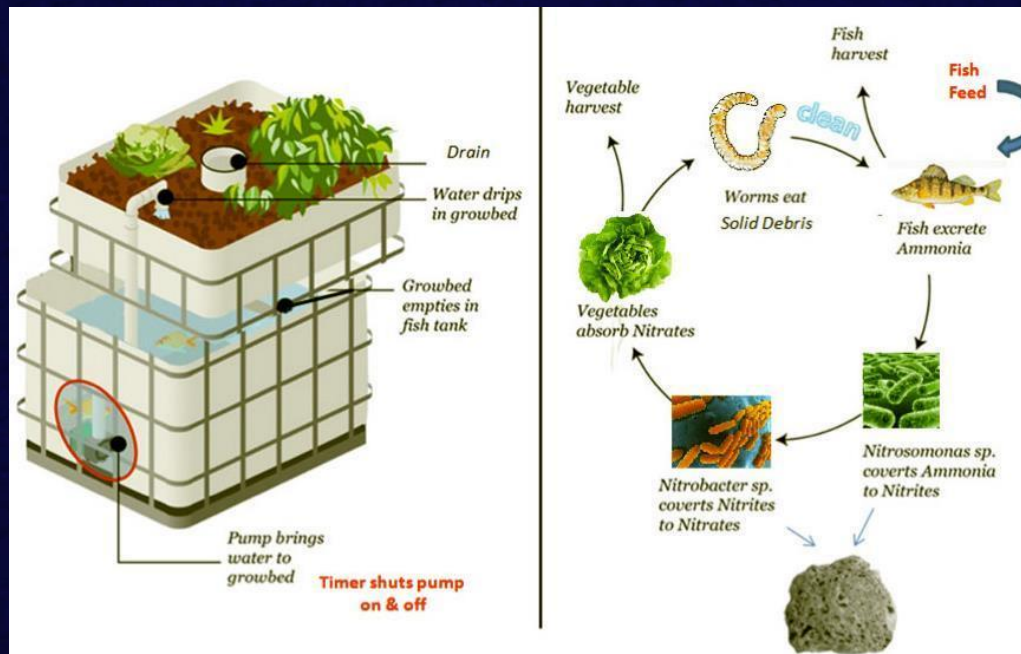
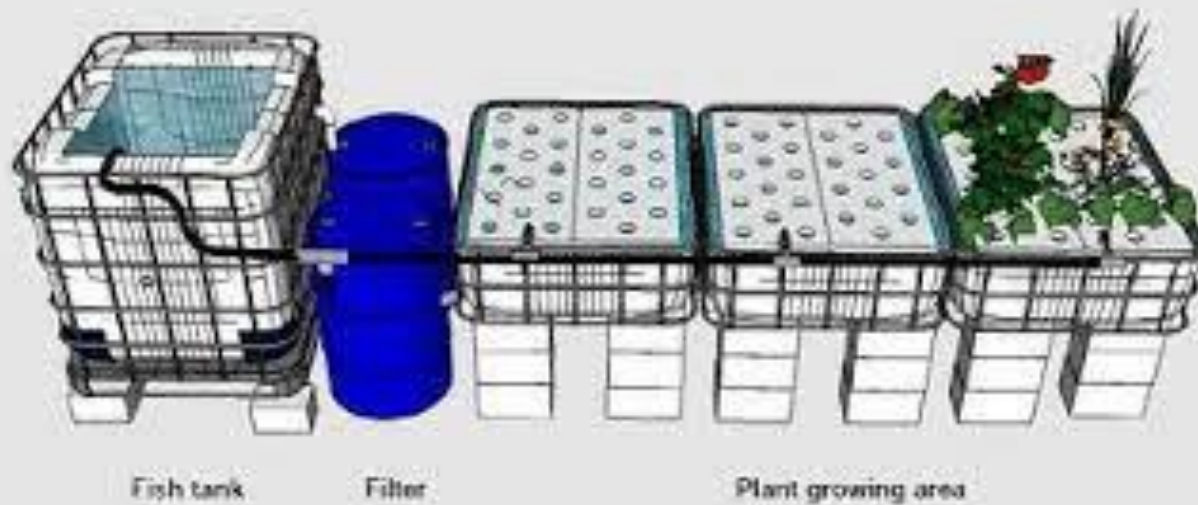


Without filter



Using filter





Biofilter

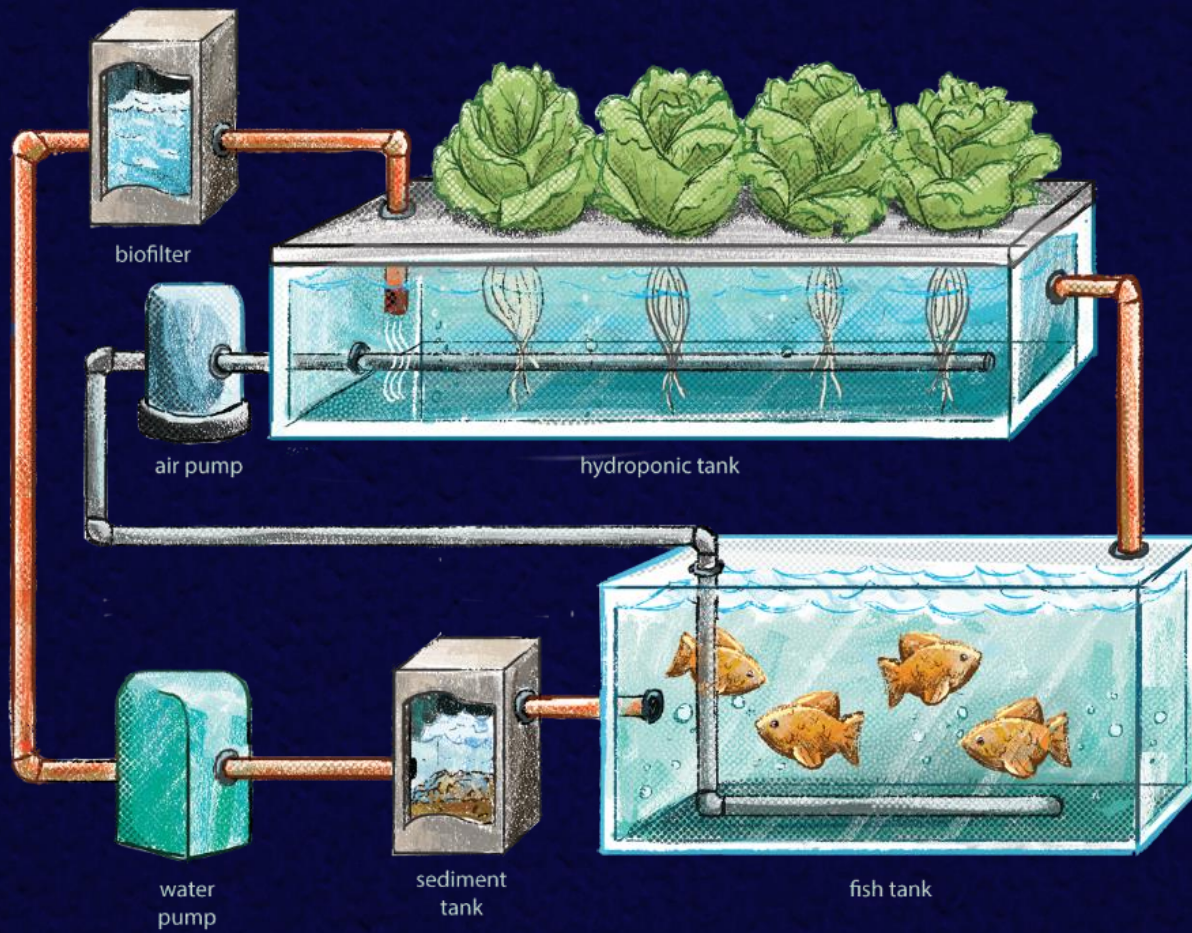


Bio ball



Kaldness







Thank You

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