

# Soil Fertility Management



*Touria Eaton, Ph.D.  
State Extension Specialist  
Lincoln University of Missouri  
eatont@lincolnu.edu*

# Soil Fertility Management

All nutrients available

Appropriate concentrations

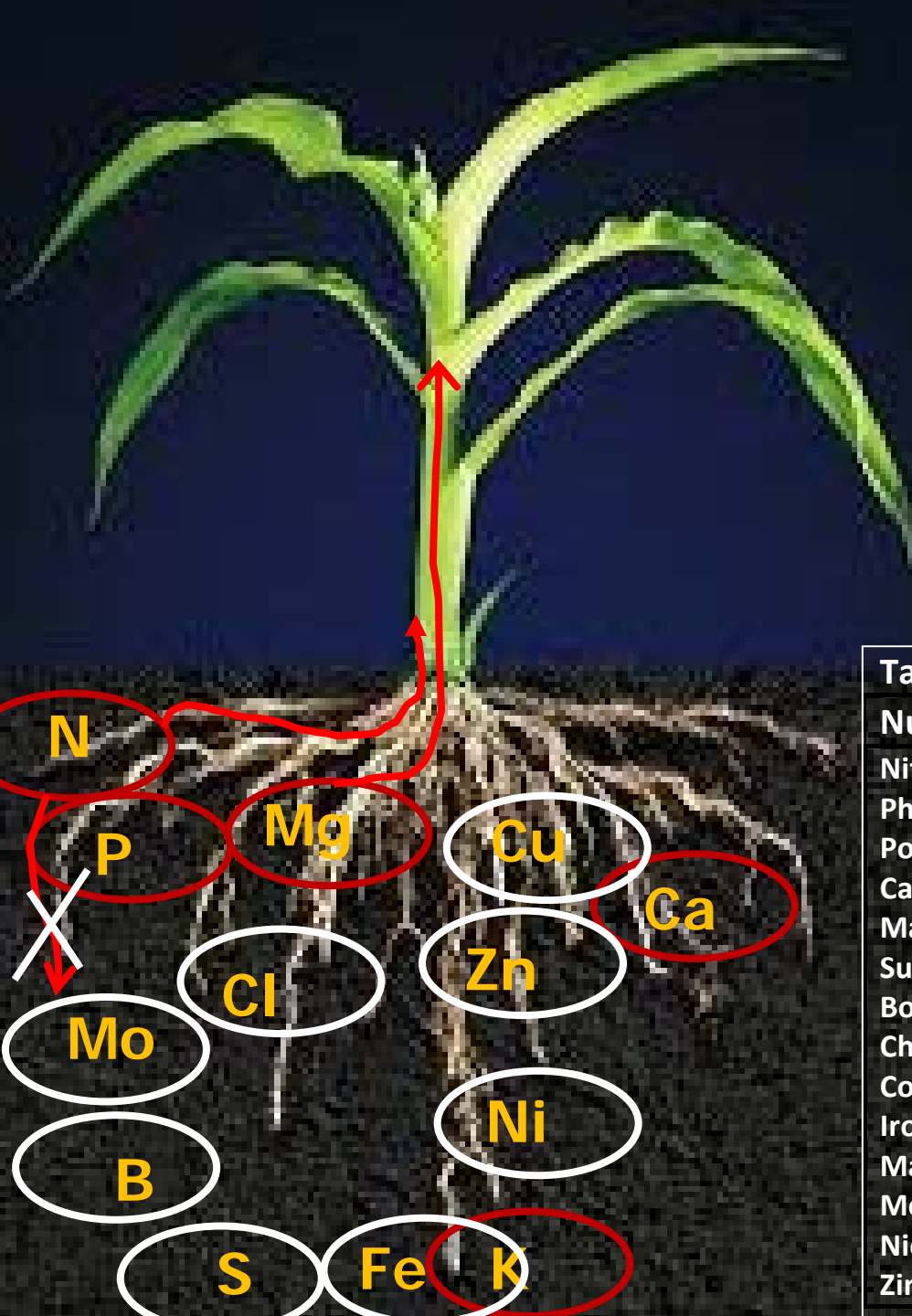


Table 1: Plant nutrients

Nutrient	Symbol	Function in plants
Nitrogen	N	protein, amino acid
Phosphorus	P	Nucleic acid, ATP
Potassium	K	Catalyst, ion transport
Calcium	Ca	Cell wall component
Magnesium	Mg	Part of chlorophyll
Sulfur	S	Amino acid
Boron	B	Cell wall component
Chlorine	Cl	Photosynthesis reactions
Copper	Cu	Component of enzymes
Iron	Fe	Chlorophyll synthesis
Manganese	Mn	Activates enzyme
Molybdenum	Mo	Involved in N fixation
Nickel	Ni	Component of enzymes
Zinc	Zn	Activates enzymes

# Soil Fertility Management

All nutrients available

Appropriate concentrations

Available form

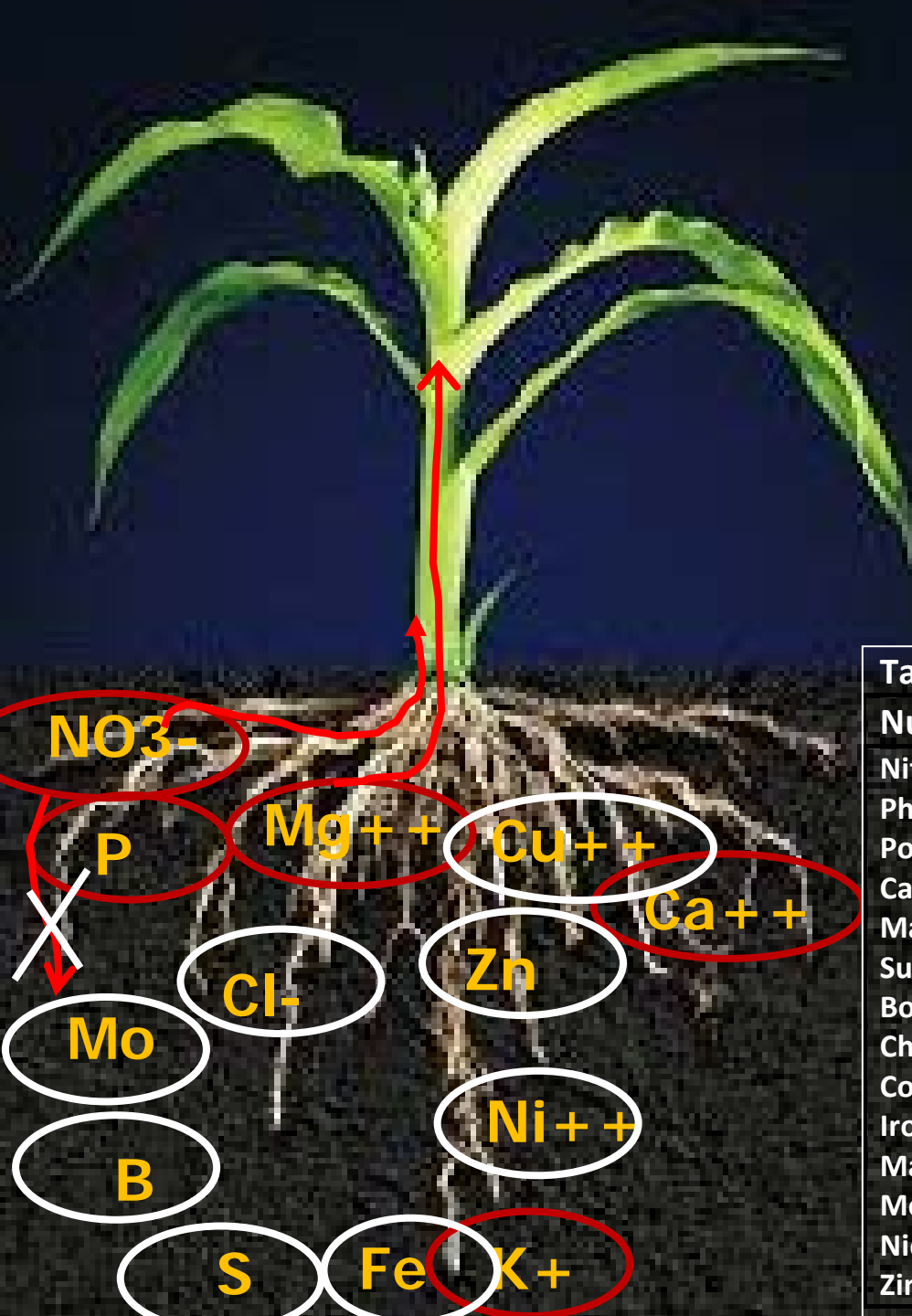


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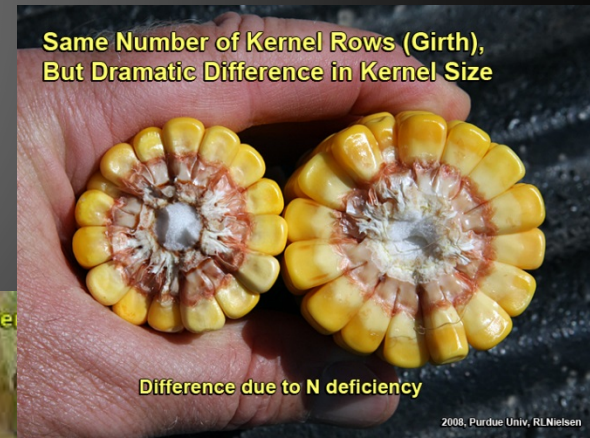
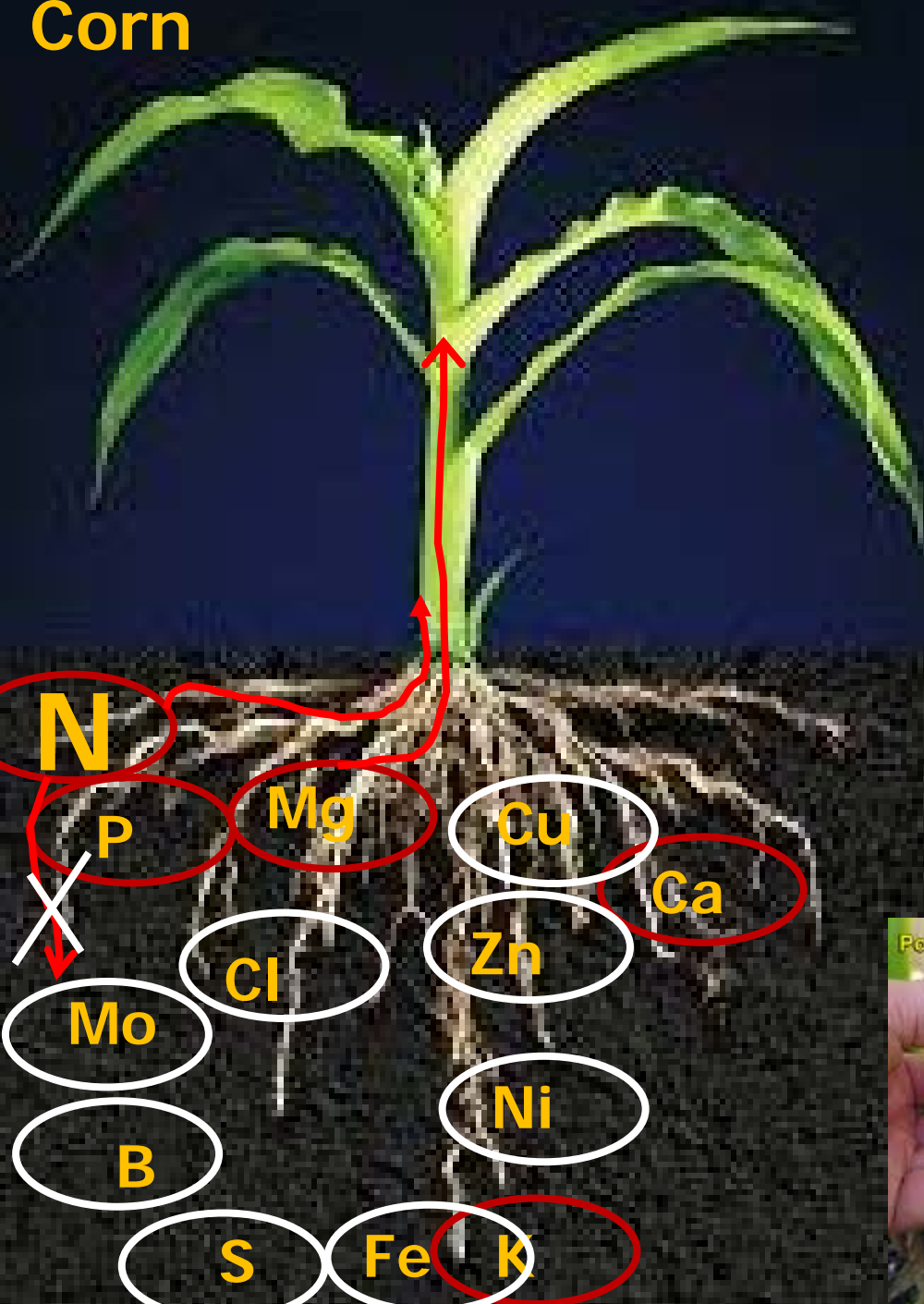
Corn

# Soil Fertility Management

Unmarketable crop

Reduced yield

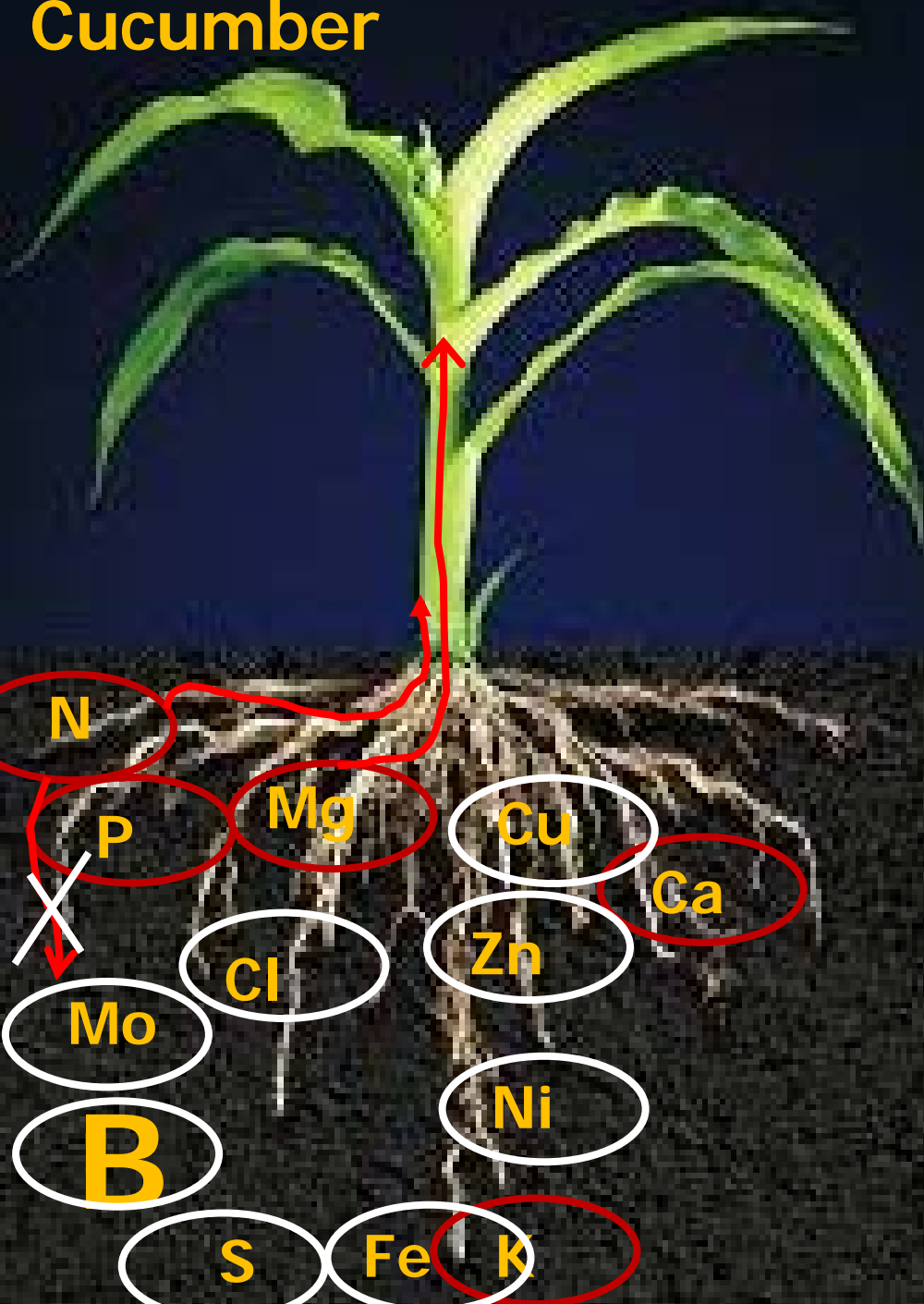
Economic loss



2008, Purdue Univ. RL Nielsen

2008, Purdue Univ. RL Nielsen

# Cucumber



# Soil Fertility Management

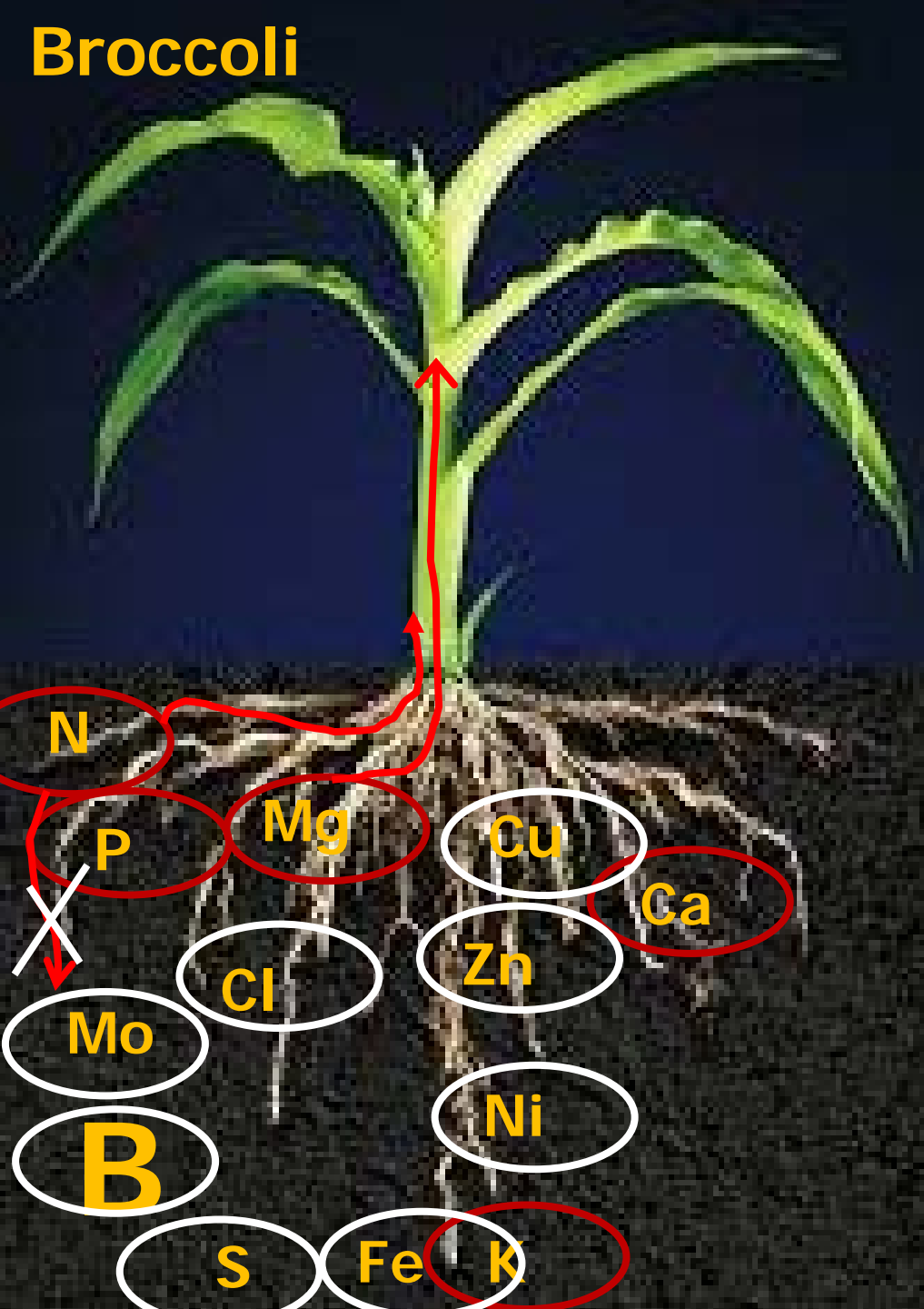
Unmarketable crop

Reduced yield

Economic loss



# Broccoli



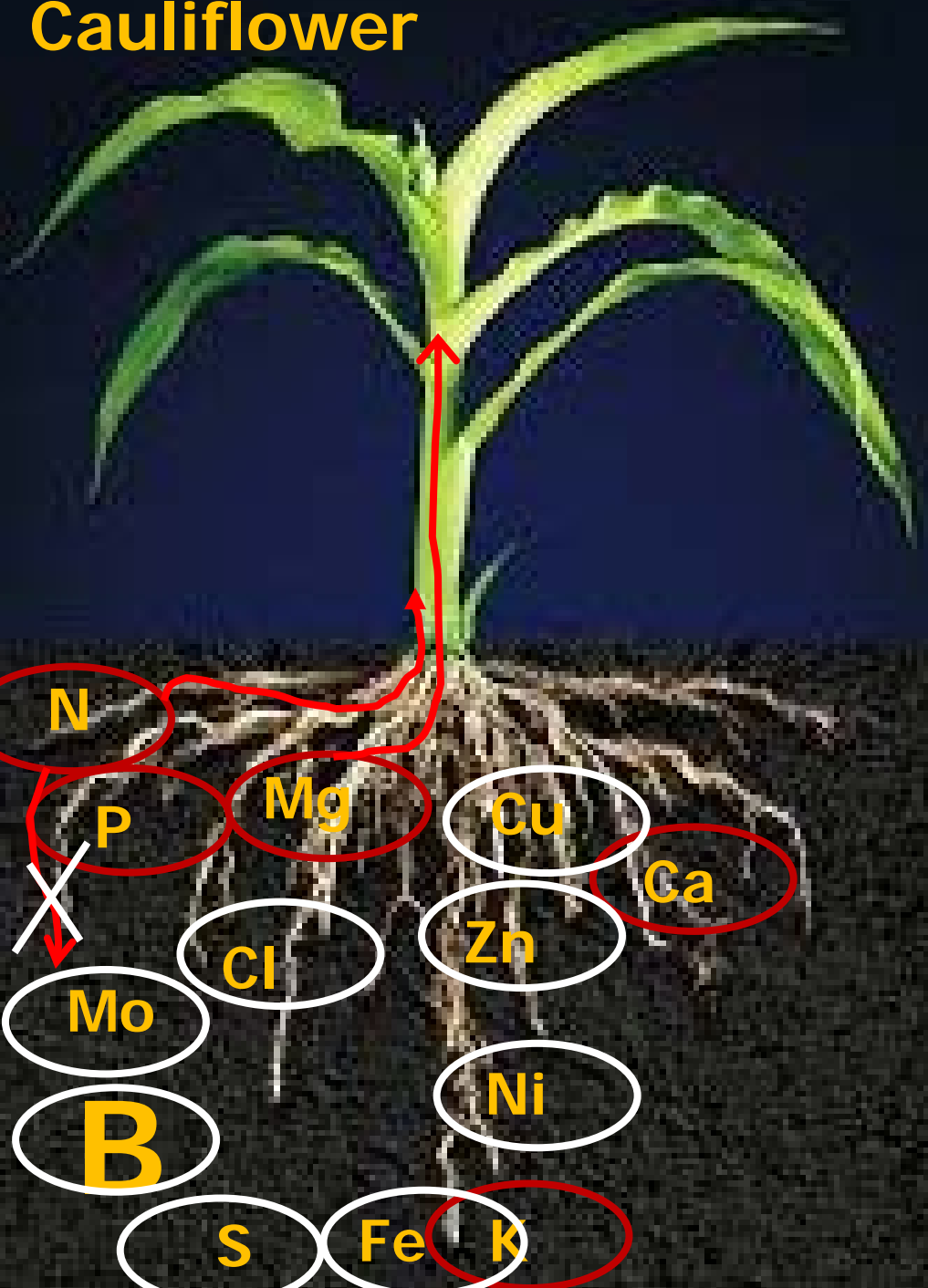
# Soil Fertility Management

Unmarketable crop

Economic loss



# Cauliflower



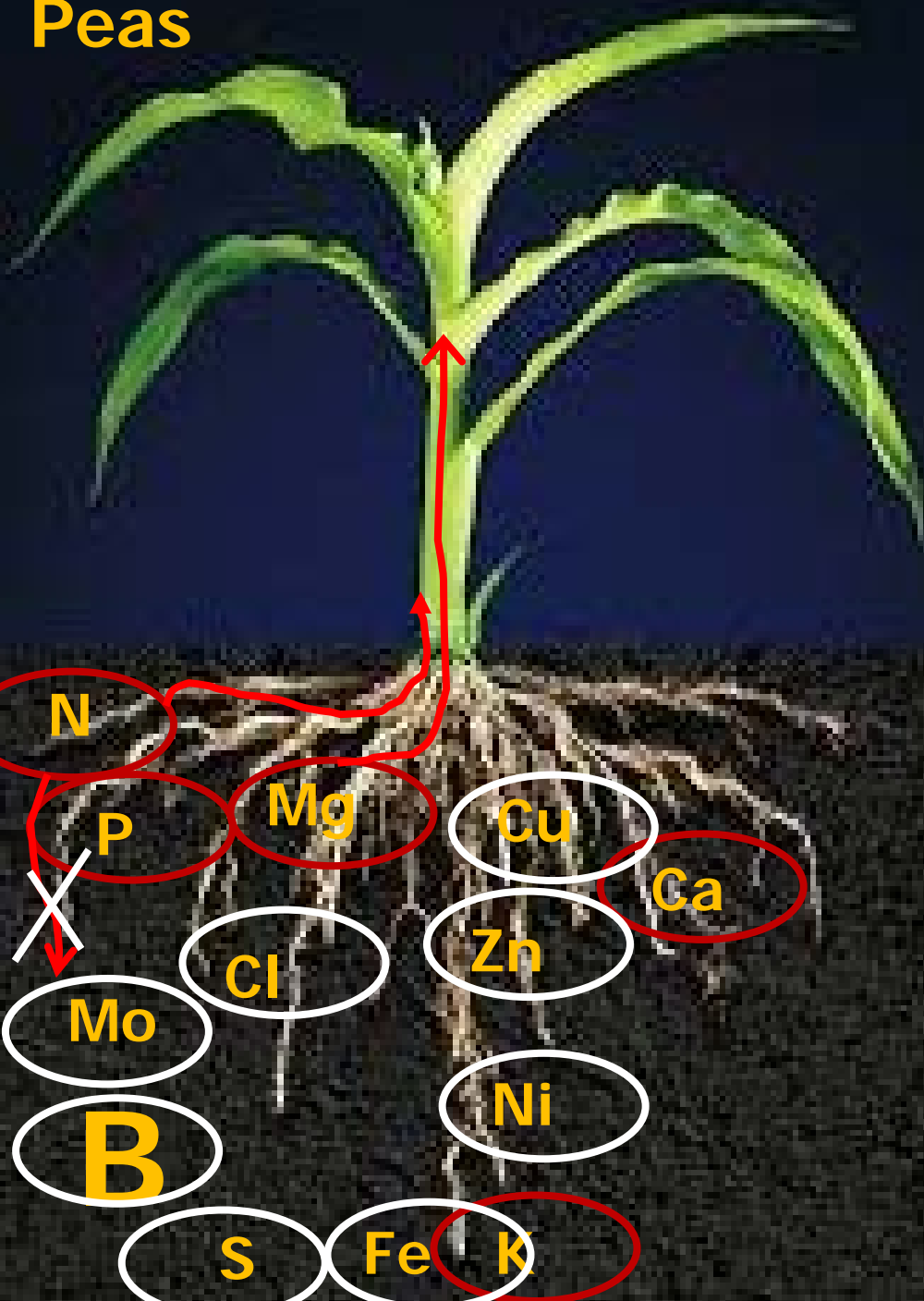
# Soil Fertility Management

Unmarketable crop

Economic loss



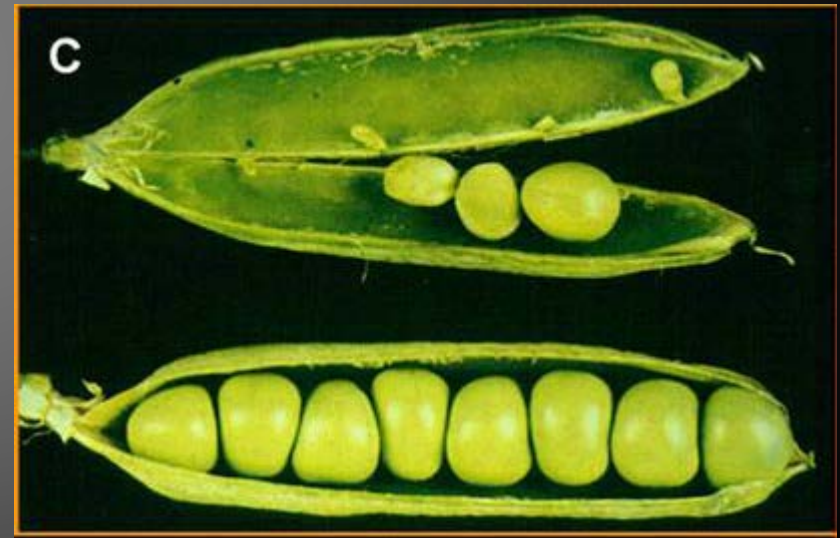
Peas



# Soil Fertility Management

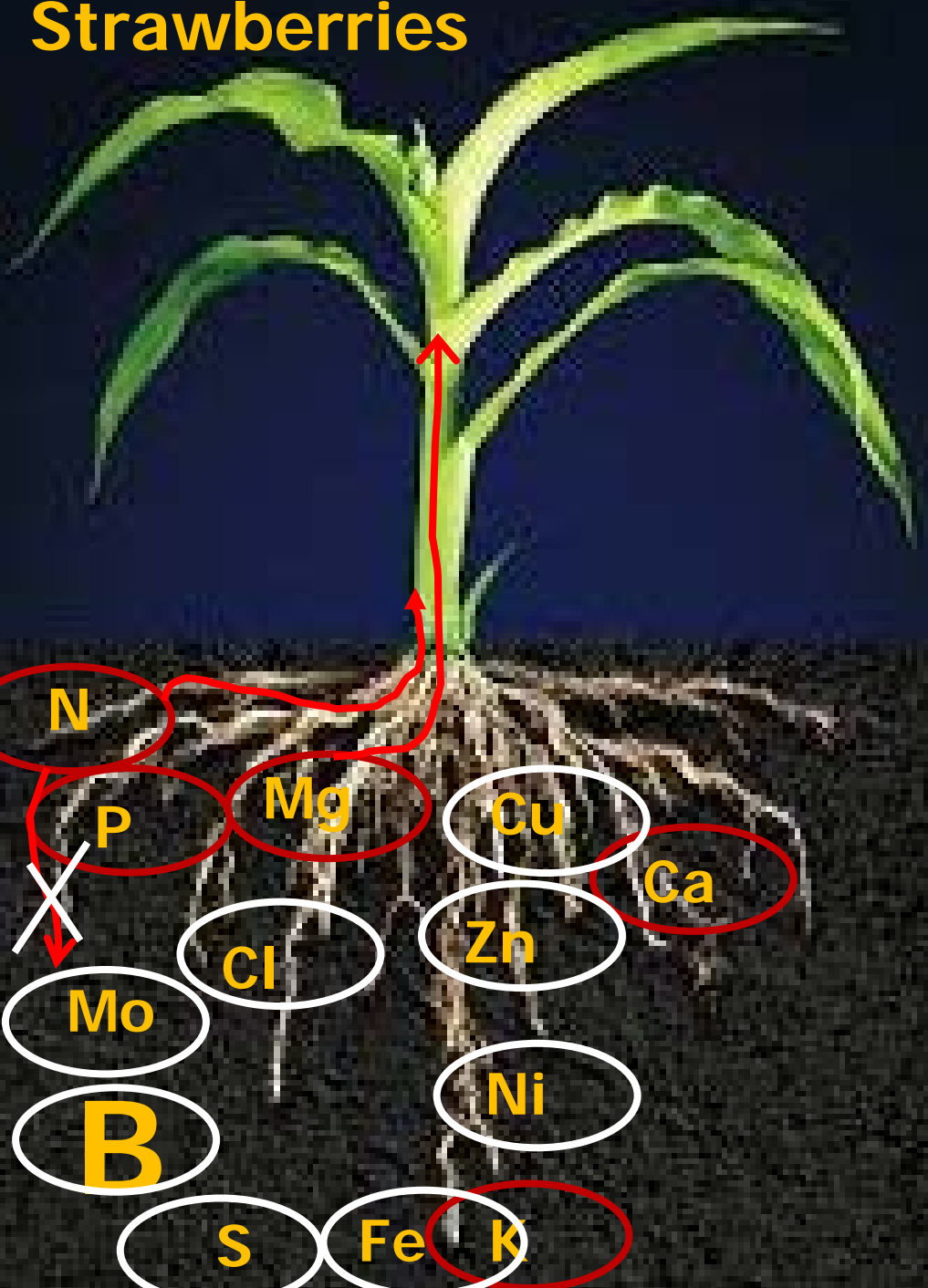
Reduced yield

Economic loss





# Strawberries



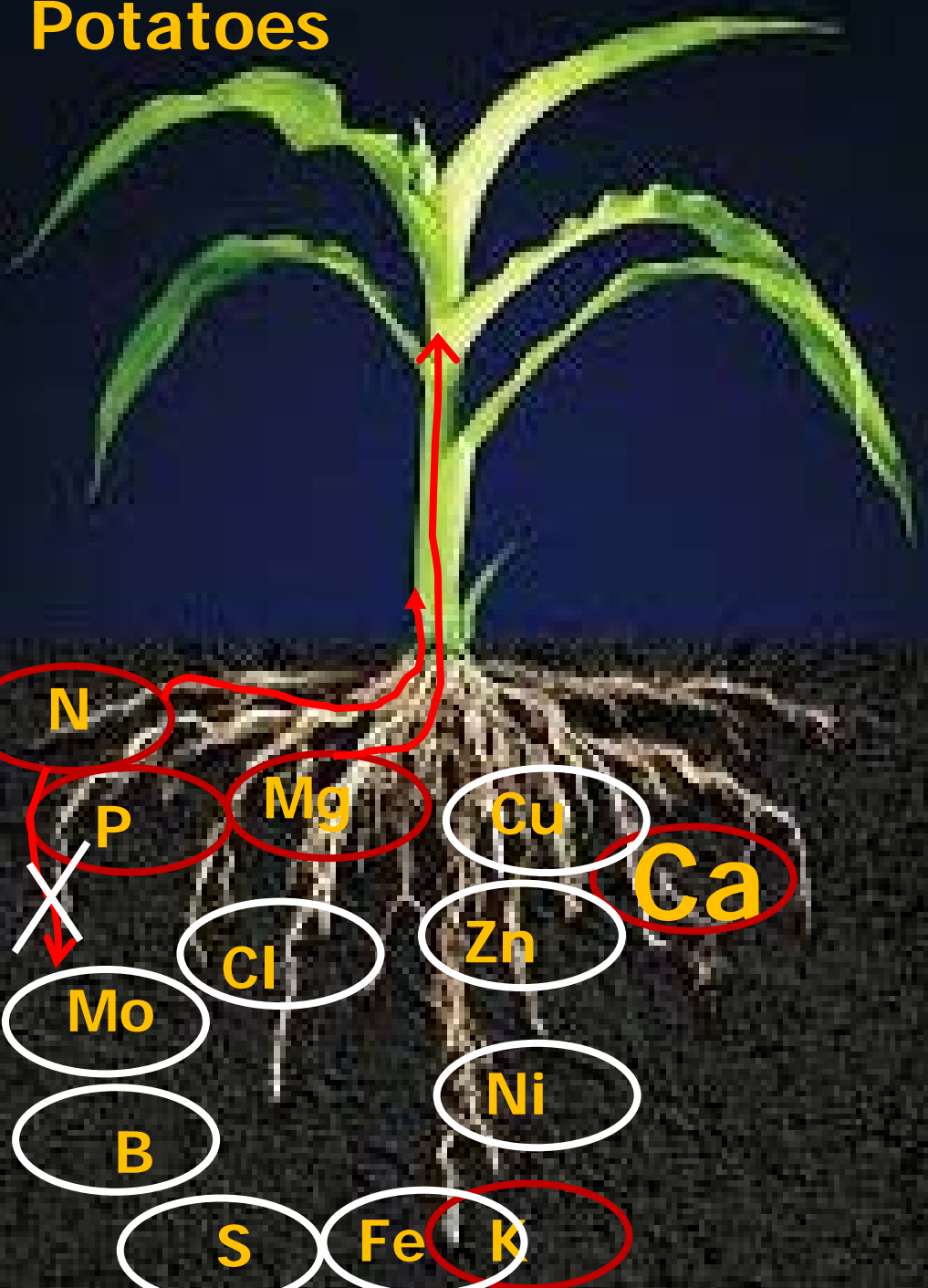
# Soil Fertility Management

Unmarketable fruit

Economic loss



# Potatoes



# Soil Fertility Management

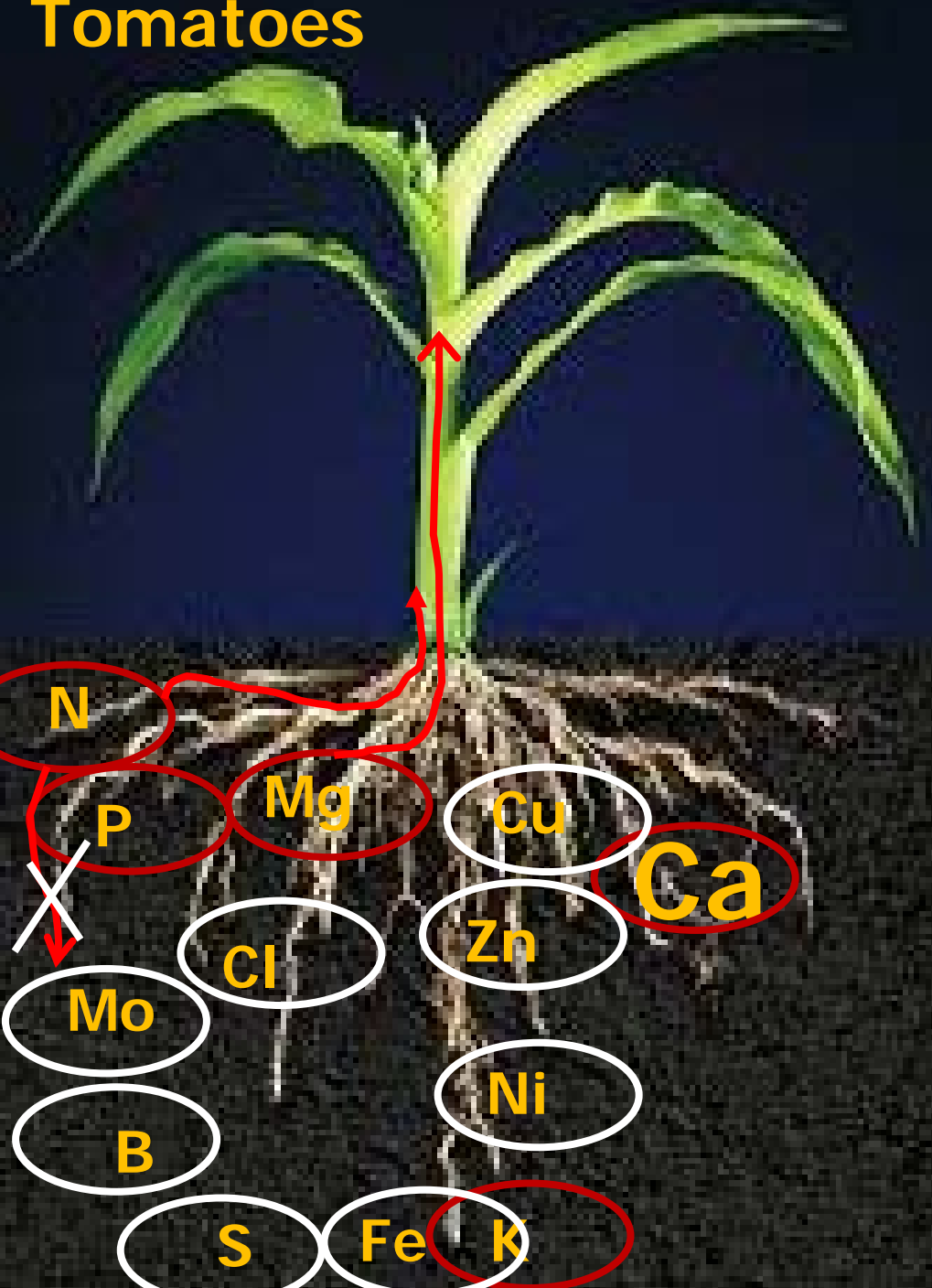
Unmarketable crop

Reduced yield

Economic loss



# Tomatoes



# Soil Fertility Management

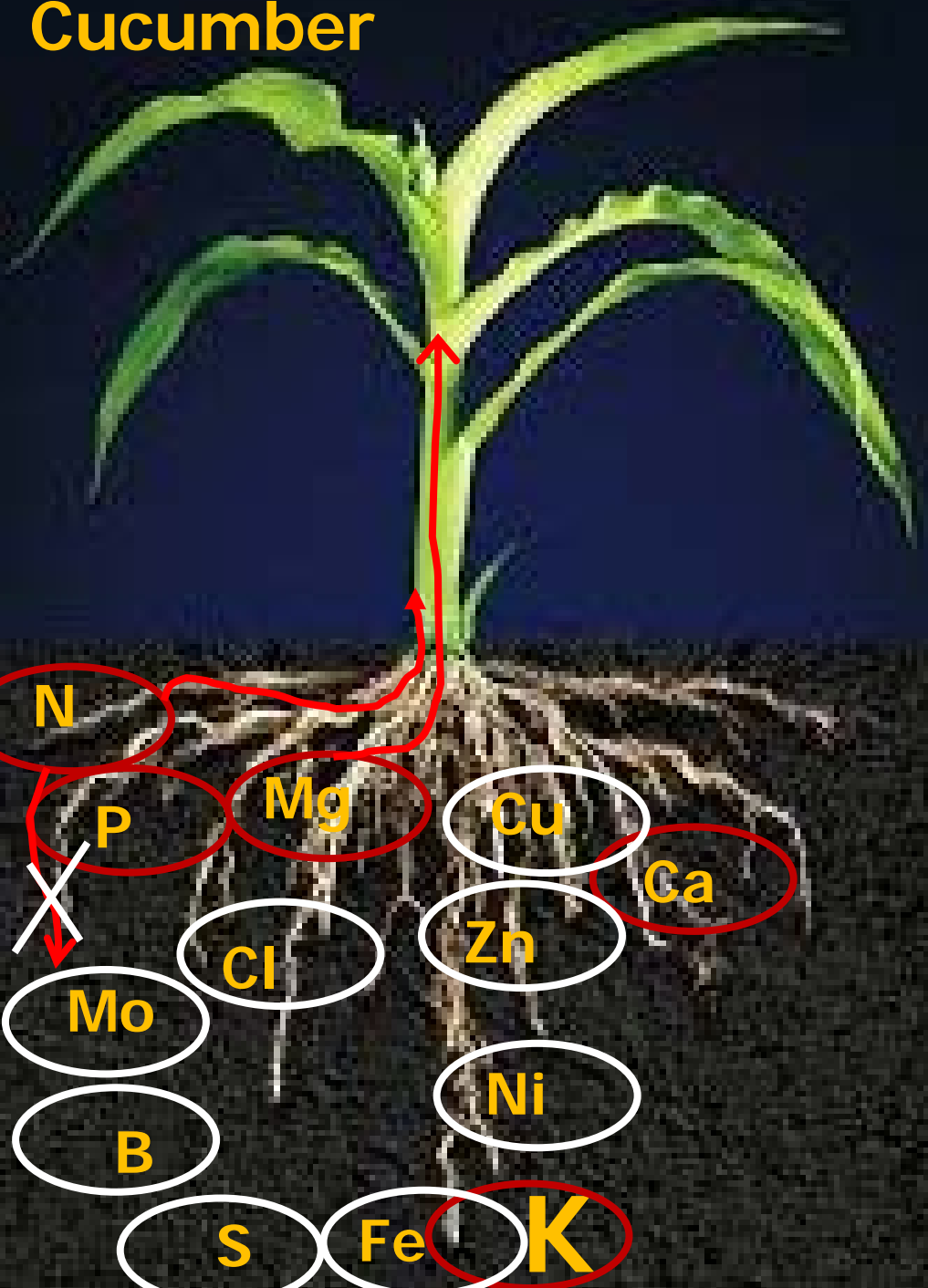
Unmarketable crop

Reduced yield

Economic loss



# Cucumber



# Soil Fertility Management

Unmarketable fruit

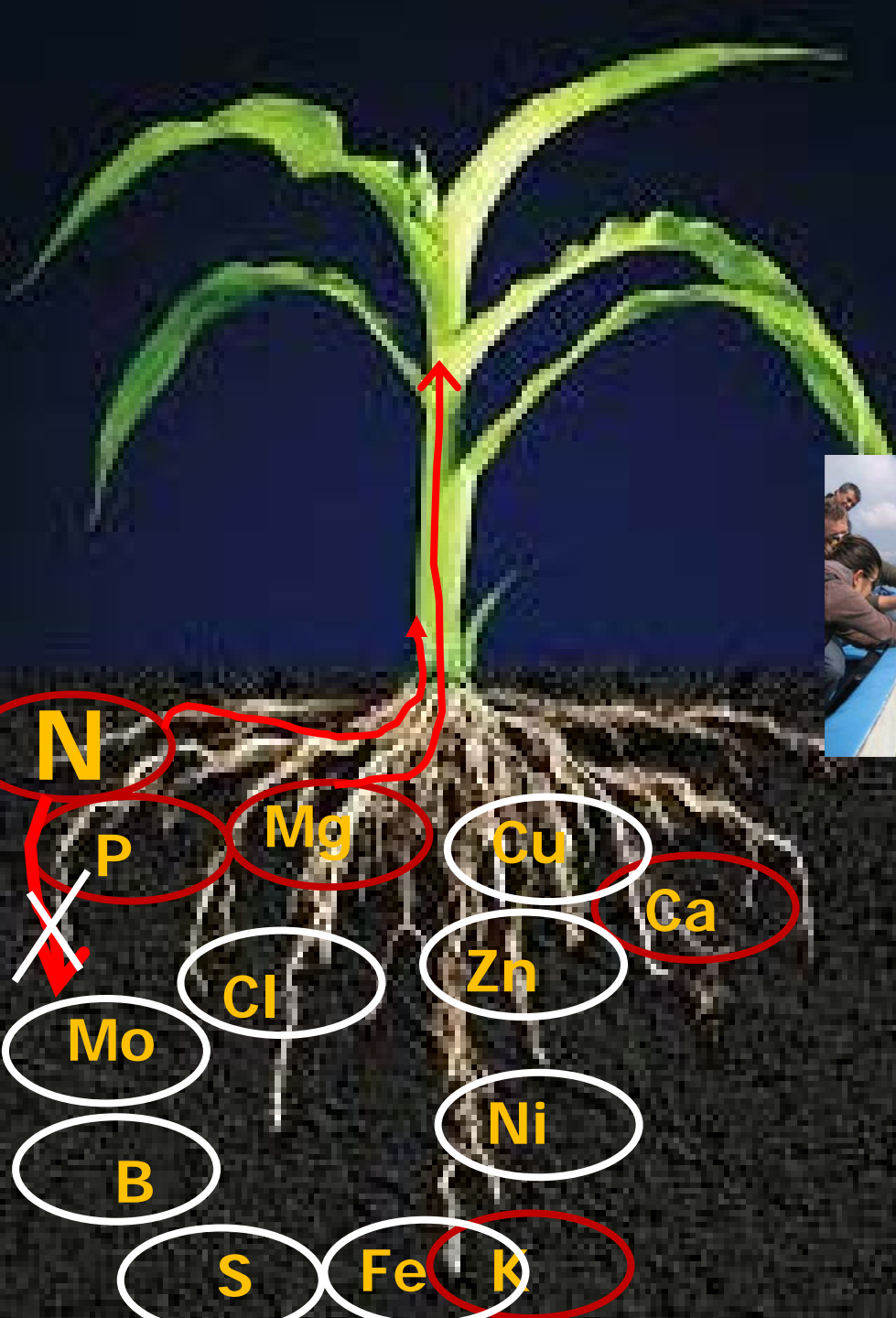
Economic loss



# Soil Fertility Management

Eutrophication

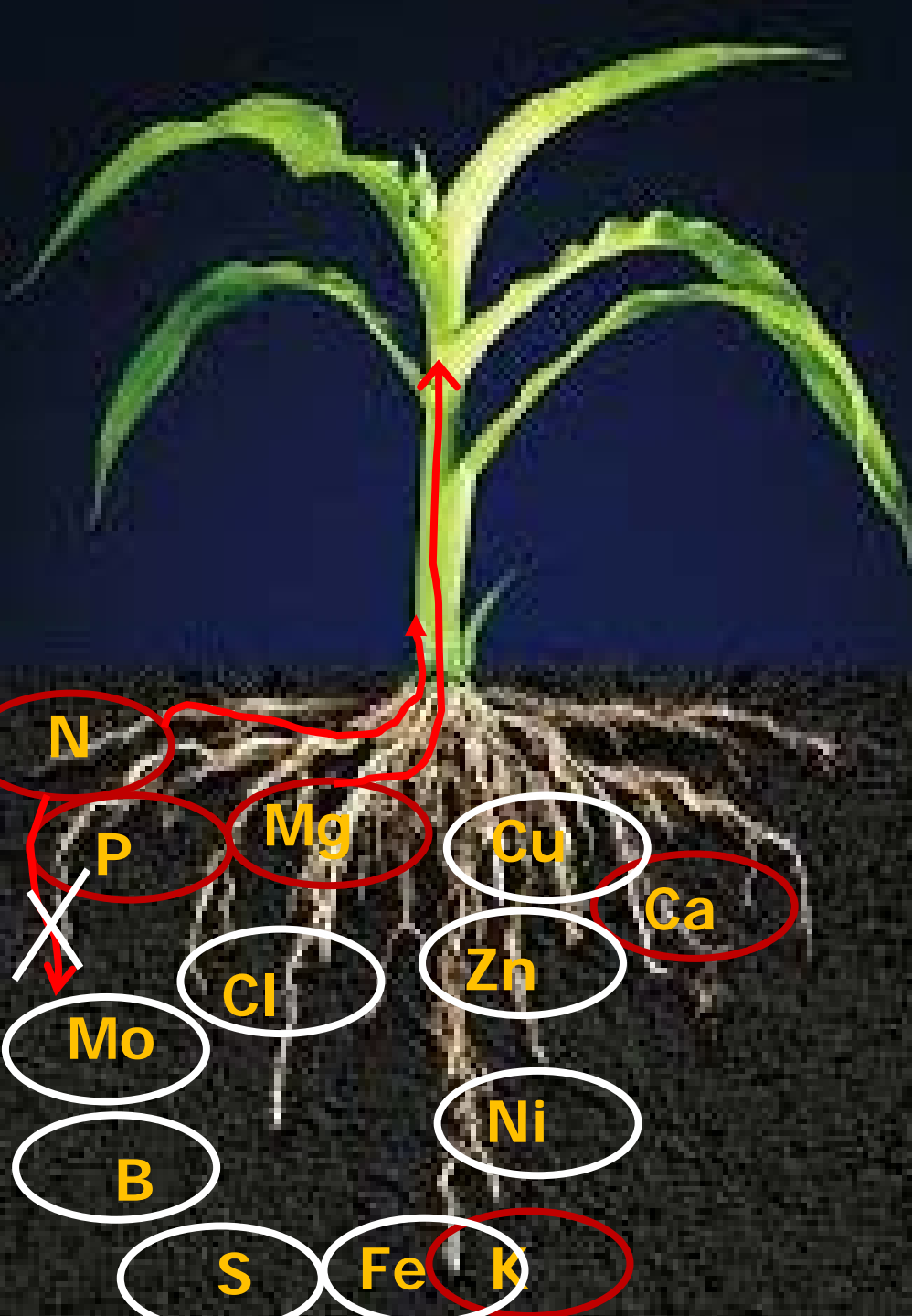
Economic loss



# Soil Fertility Management

## Goal

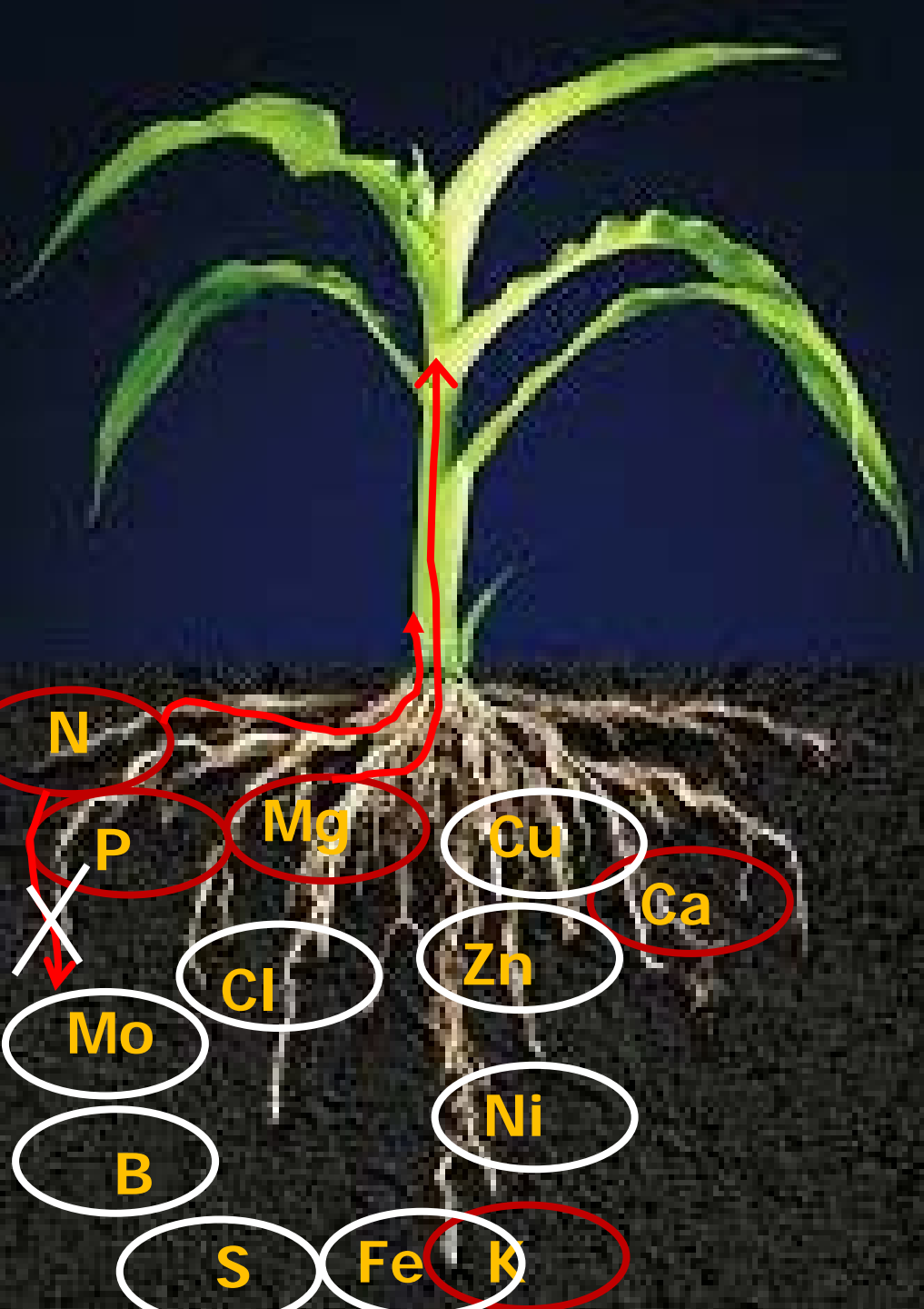
- Avoid unmarketable crops
- Avoid reduced yield
- Avoid pollution



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms
3. Nutrients are mobile in the soil and in the plant
4. Healthy root system



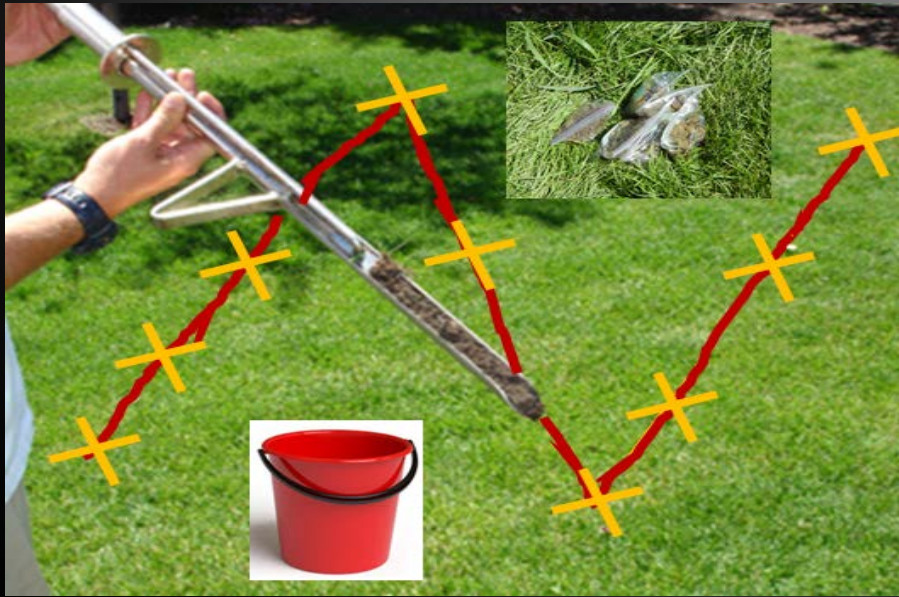
# Soil Test



# Soil Fertility Management

**Needed**

1. Nutrients in the soil in appropriate quantities







# Soil Test Report

Soil Testing Laboratory  
23 Mumford Hall, MU  
Columbia, MO 65211  
Phone: (573) 882-0823

or

Soil Testing Laboratory  
P.O. Box 160  
Perageville, MO 63873  
Phone: (573) 378-5431



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities

## Soil Test



## Soil Test Report

FIELD INFORMATION			
Field ID	Hill top field	Sample no.	1
Acres	40	Last Lined	Not known
		Irrigated	No
Last crop	019 Cool-Season Grass Pasture		

**A**

Serial no.	M9999	Lab no.	9969999
Area	015	County	010
		Region	3
Submitted	06/10/96		
	Processed 06/12/96		

Soil sample submitted by:

This report is for:  
Example Report  
University of Missouri  
Columbia, MO 65211

**C**

B SOIL TEST INFORMATION	C RATING					
	Very low	Low	Medium	High	Very High	Excess
pH <sub>s</sub> (salt pH)	4.9	*****				
Phosphorus (P)	22 lbs/acre	*****				
Potassium (K)	303 lbs/acre	*****				
Calcium (Ca)	2091 lbs/acre	*****				
Magnesium (Mg)	278 lbs/acre	*****				
Sulfur (SO <sub>4</sub> -S)	ppm					
Zinc (Zn)	ppm					
Manganese (Mn)	ppm					
Iron (Fe)	ppm					
Copper (Cu)	ppm					
Organic matter	2.2 %	Neutralizable acidity	6.0 meq/100g	Cation Exch. Capacity	12.8 meq/100g	
pH in water		Electrical Conductivity	mmho/cm	Sodium (Na)	lbs/8	
Nitrate (NO <sub>3</sub> -N)	ppm	Topsoil	ppm	Subsoil	ppm	
		Sampling Depth	Top	Inches	Subsoil	Inches

E Cropping options	D Yield goal	F Pounds per acre					G	H LIMESTONE SUGGESTIONS
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	S		
Alfalfa/Grass Establishment	0	20	55	0			Effective neutralizing material (ENM)	
Clover/Grass Establishment	0	20	45	0			1,395	
Alfalfa/Grass Hay	6	0	80	235			Effective magnesium (EMg)	
Cool-Season Grass Pasture	150 CD/A	90	30	20				

**I**

To determine limestone needs in tons/acre, divide ENM requirements by the guarantee of your limestone dealer.

When N requirement for cool-season grass exceeds 90 lbs/acre, apply 2/3 of it during the period from December through February, and the remainder in August.

Do not use nitrogen on spring seedlings of legumes after May 1st because of potential weed competition.

# Soil Fertility Management

## Needed

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Example Report  
University of Missouri  
Columbia, MO 65211

Serial no. M9999	Lab no. 9969999
Area 015	County 010 Region 3
Submitted	Processed
06/10/96	06/12/96

Soil sample submitted by:

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Magnesium (Mg)	278 lbs/acre	*****				
Sulfur (SO <sub>4</sub> -S)	ppm					
Zinc (Zn)	ppm					
Manganese (Mn)	ppm					
Iron (Fe)	ppm					
Copper (Cu)	ppm					
Organic matter	2.2 %	Neutralizable acidity	6.0 meq/100g	Cation Exch. Capacity	12.8 meq/100g	
pH in water		Electrical Conductivity	mmho/cm	Sodium (Na)	lbs/a	
Nitrate (NO <sub>3</sub> -N)	ppm	Subsoil	ppm	Sampling Depth	Top	Inches
					Subsoil	inches

E Cropping options	D Yield goal	G Pounds per acre					H LIMESTONE SUGGESTIONS
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## Soil Test



## Soil Test Report

# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities

Soil Test



Soil Test Report



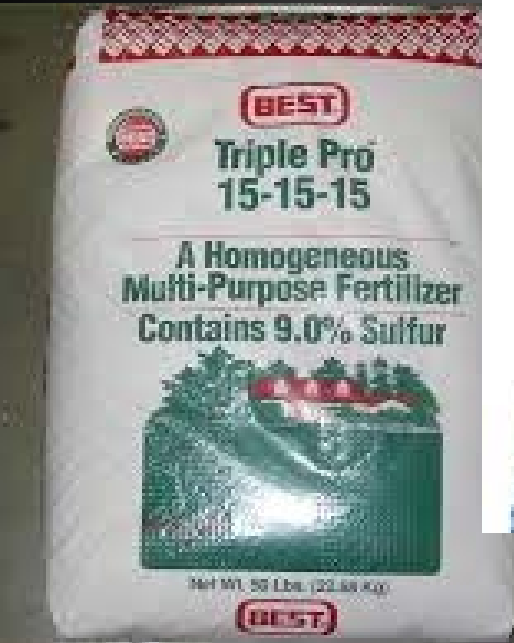
# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities

Soil Test



Soil Test Report





Compost

# Soil Fertility Management

**Needed**

1. Nutrients in the soil in appropriate quantities



Soil Test



Soil Test Report

# Soil Fertility Management

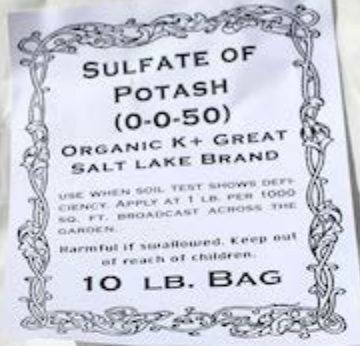
## Needed

1. Nutrients in the soil in appropriate quantities

Soil Test



Soil Test Report



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities

## Challenge



## Nutrient losses



## Organic Matter

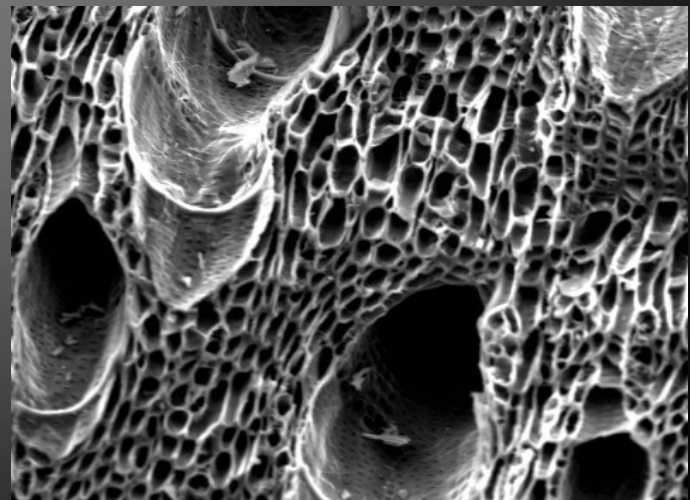
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## Bank for Nutrients

# Biochar



- ❑ Charcoal created by pyrolysis of biomass
- ❑ Used for crop production





**Infertile soil**



**Fertile soil  
(terra preta) (black earth)**

# History

- Amazonians used biochar to amend their soils
- Amazonian earthworm (*Pontoscolex corethrurus*) responsible for powdering and incorporation of biochar in the soil

# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities

Challenge



Nutrient losses



Split Fertilization

# Soil Fertility Management

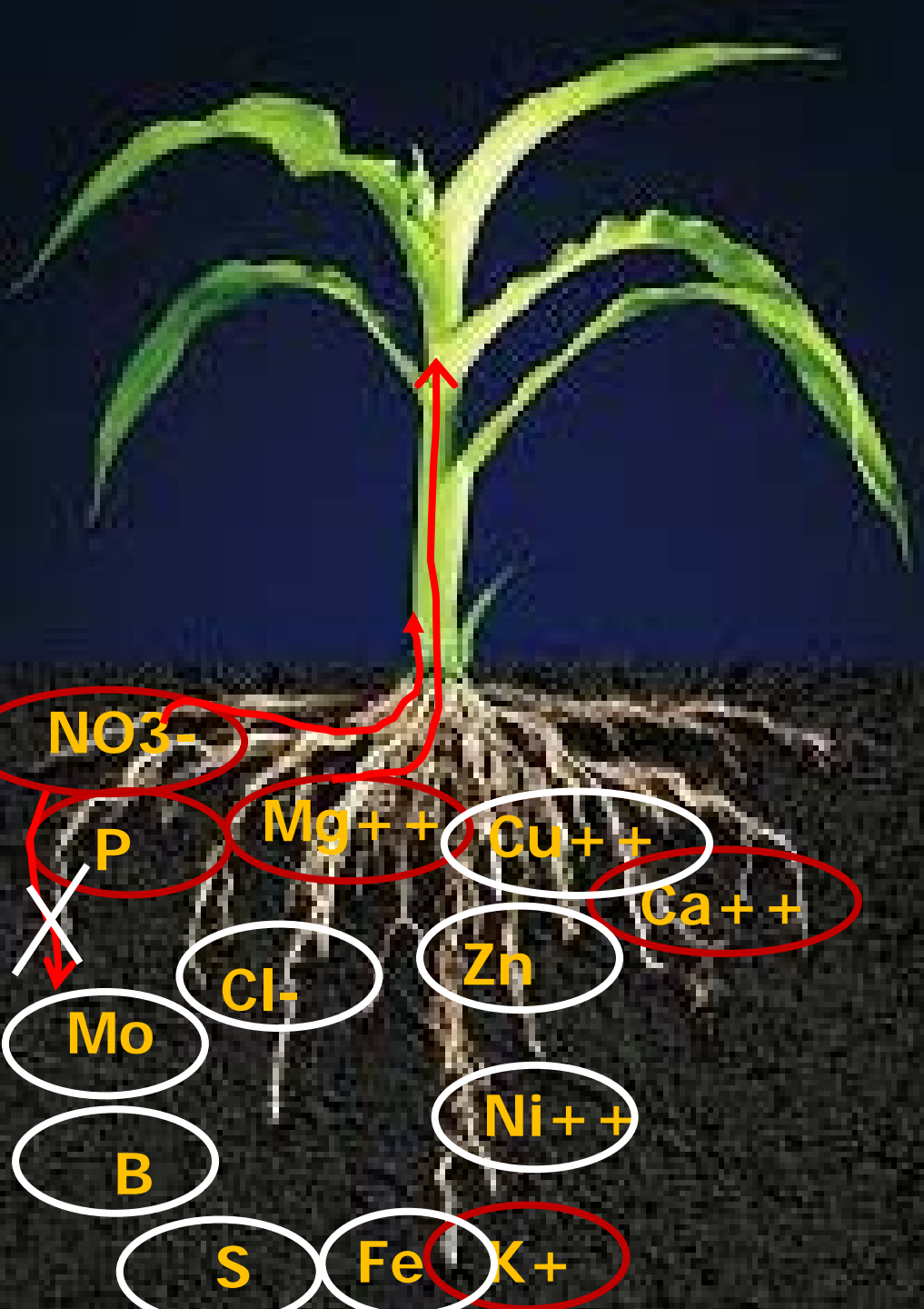
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1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

Soil Test



Soil Test Report





# Soil Fertility Management

## Needed

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Calcium	(Ca) 2091 lbs/acre	*****					
Magnesium	(Mg) 278 lbs/acre	*****					
Sulfur	(SO <sub>4</sub> -S) ppm						
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Manganese	(Mn) ppm						
Iron	(Fe) ppm						
Copper	(Cu) ppm						
Organic matter	2.2 %	Neutralizable acidity	6.0 meq/100g	Cation Exch. Capacity	12.8 m		
pH in water		Electrical Conductivity	mmho/cm	Sodium (Na)			
Nitrate (NO <sub>3</sub> -N)	Topsoil ppm	Subsoil ppm	Sampling Depth	Top	Inches	Subsoil	

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

**D NUTRIENT REQUIREMENTS**

<b>E</b> Cropping options	<b>F</b> Yield goal	<b>G</b> Pounds per acre					<b>H</b> LIMESTONE SUGGESTIONS
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	S	
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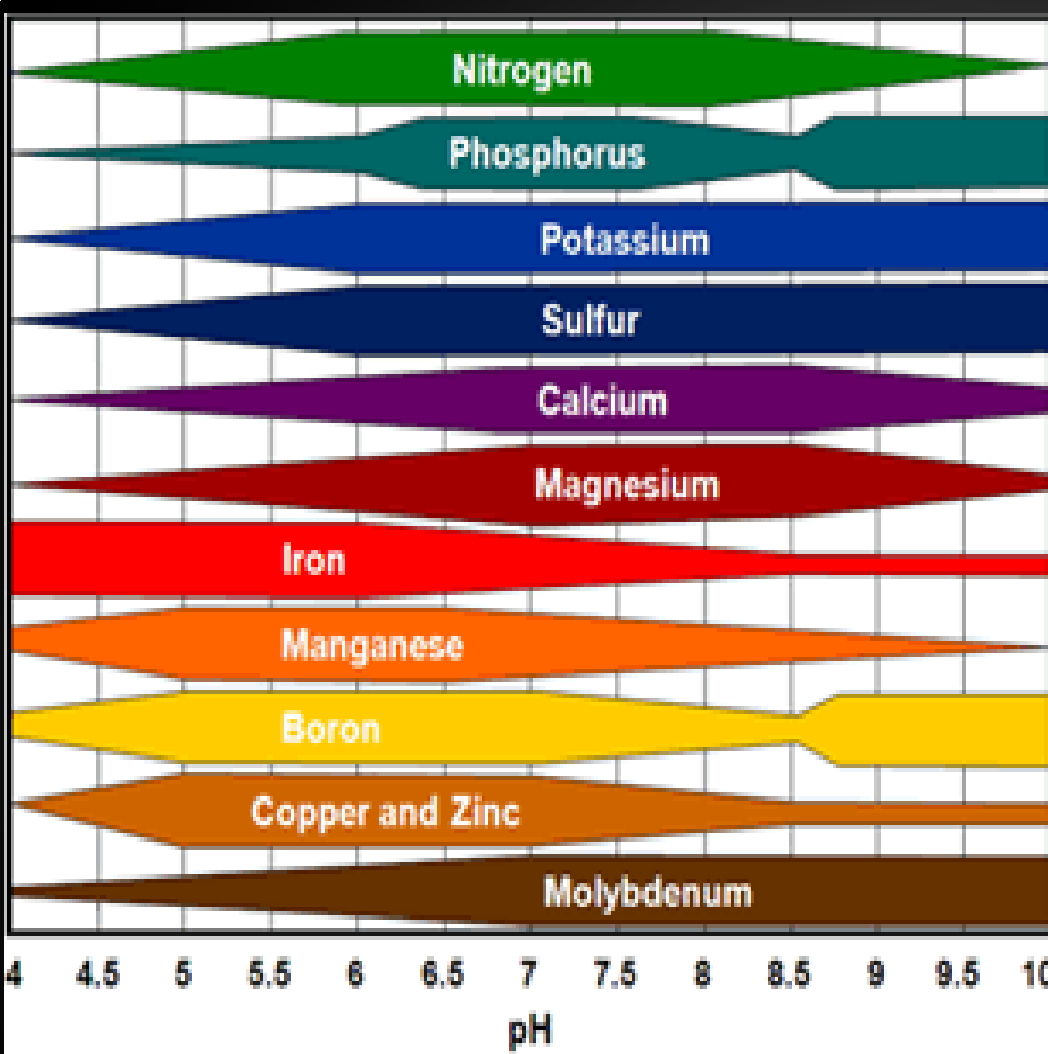
## Soil Test



## Soil Test Report

# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms



**pH of the soil**

**Indicative of nutrient  
availability in the soil**

**Soil Test**



**Soil Test Report**

## a guide to the optimum pH for crop growth



potatoes 5.5 - 6.5



wheat & maize 6.0 - 7.5



permanent pasture 5.6 - 6.8



peas & beans 6.0 - 7.5



oats 5.5 - 7.0



barley 6.5 - 7.5



linseed 6.0 - 7.0



field vegetables 6.5 - 7.5



rye-grass mixture 5.5 - 7.0



field brassica 6.5 - 7.5



oilseed rape 6.0 - 7.5



sugar beet 6.5 - 8.0



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

## Soil Test



## Soil Test Report

**pH = 5.5-6.5**



# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

**Soil Test**



**Soil Test Report**

**Add lime if  
pH < 5.5**

**Add S if  
pH > 6.5**

**pH of 5.5 - 6.5**

Use lime to increase the pH



# Soil Fertility Management



**Needed**

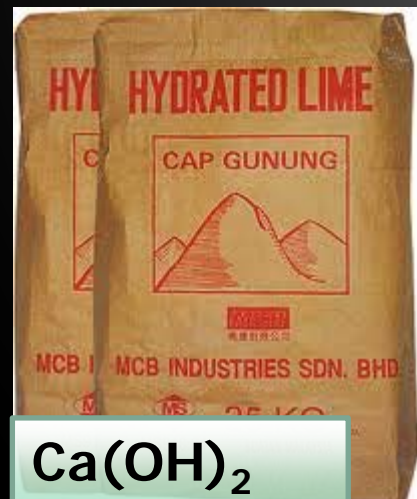


1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

Soil Test



Soil Test Report





Use lime to increase the pH



# Soil Fertility Management



**Needed**



1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

Soil Test



Soil Test Report

Lime needs:

- Contact with soil
- Water

Use Sulfur to decrease the pH



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

Soil Test



Soil Test Report

Use Sulfur to decrease the pH



Water, Temperature, and Microorganisms are important for S to work

# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms

Soil Test



Soil Test Report

Use Sulfur to decrease the pH



Water, Temperature, and Microorganisms are important for S to work

Test your soil in the fall

Apply S in the fall

# Soil Fertility Management Needed

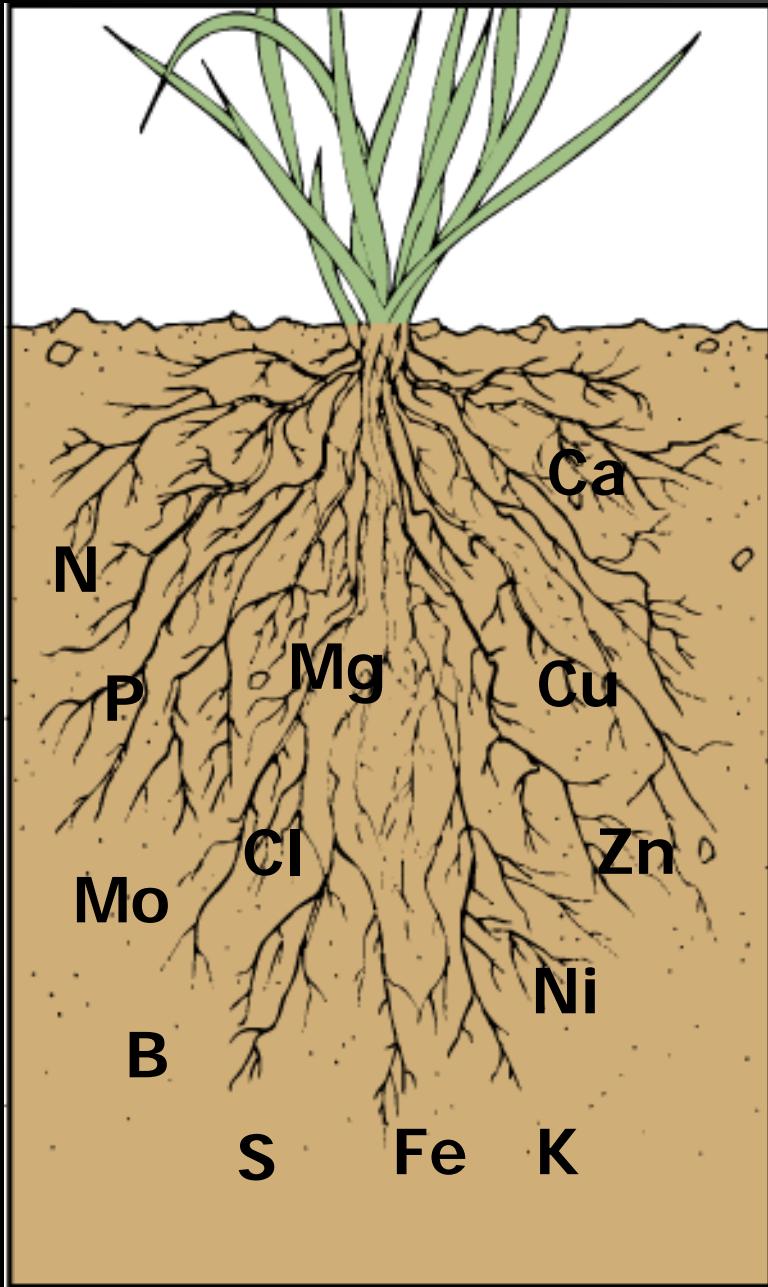
1. Nutrients in the soil in appropriate quantities
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Soil Test

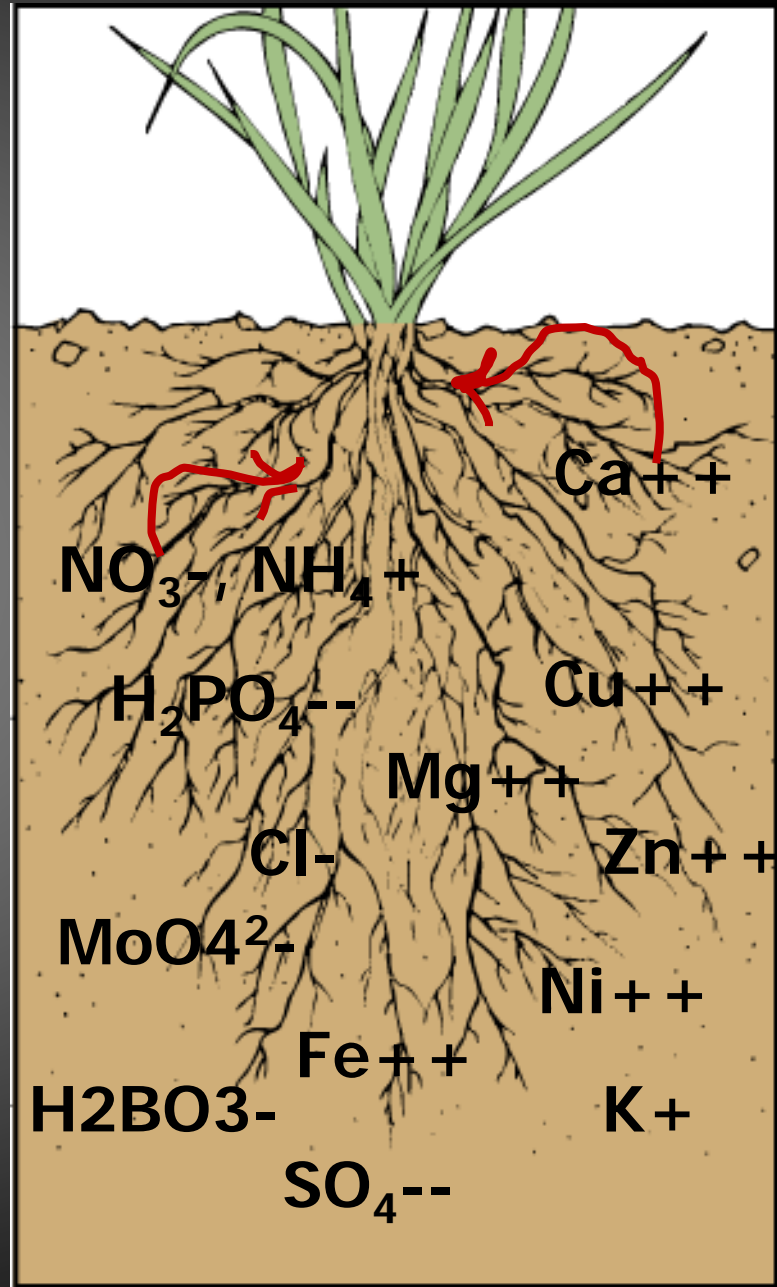


Soil Test Report

# When the pH is adjusted



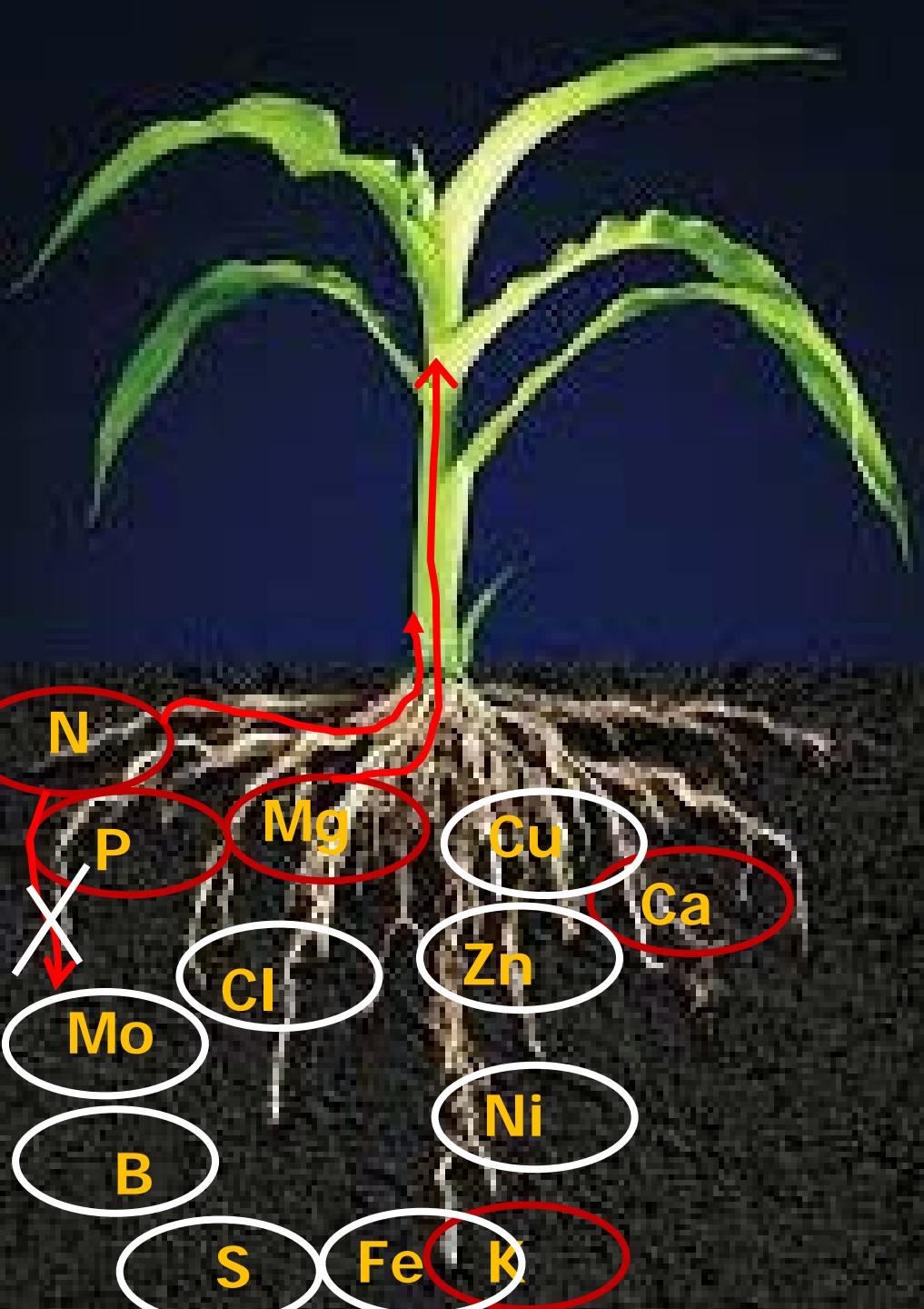
pH  
→  
adjusted



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms
3. Nutrients are mobile in the soil and in the plant



# Water Supply

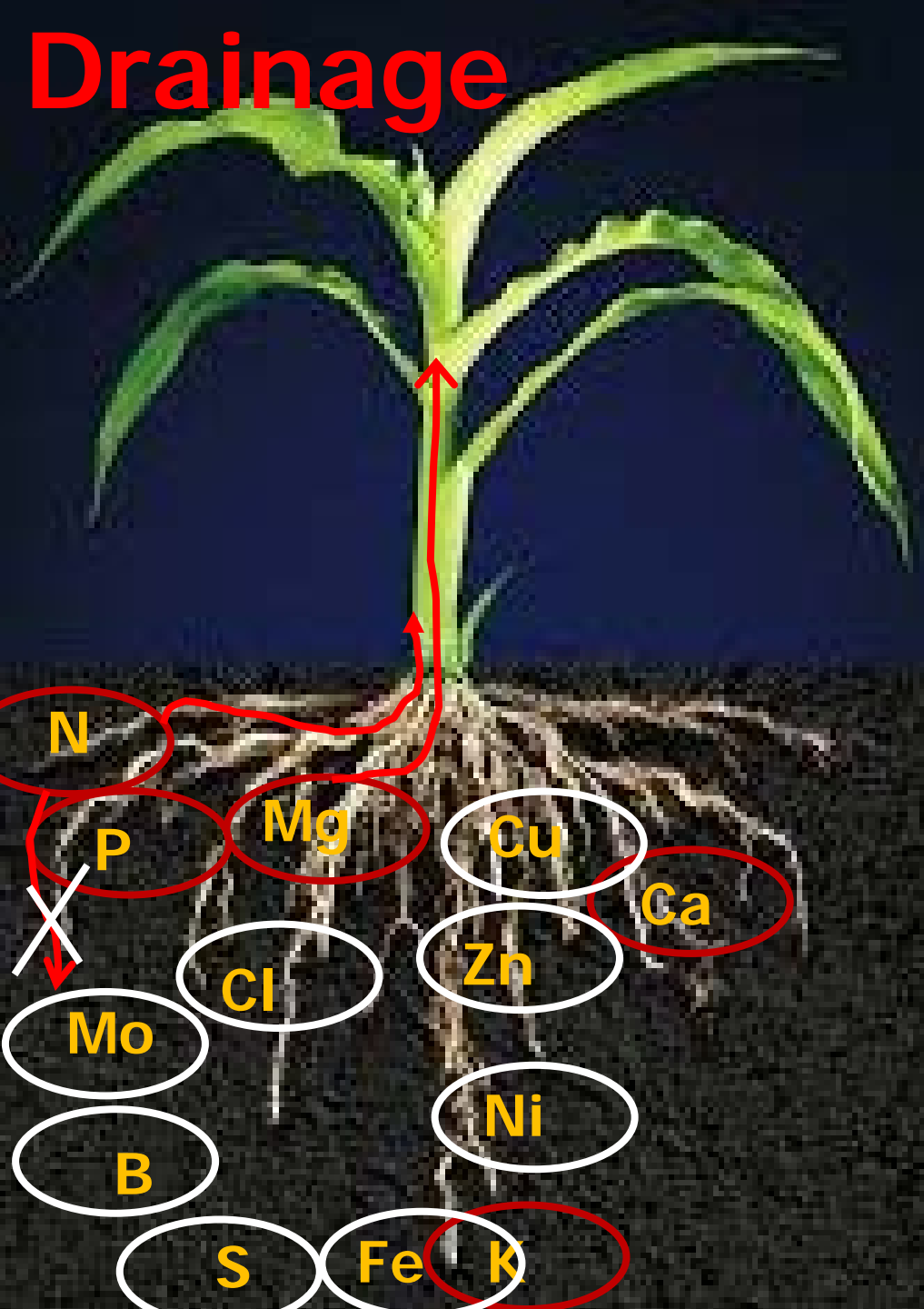


# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms
3. Nutrients are mobile in the soil and in the plant

# Drainage



# Soil Fertility Management

## Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms
3. Nutrients are mobile in the soil and in the plant
4. Healthy root system



# Drainage



Add OGM

# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities
2. Nutrients in available forms
3. Nutrients are mobile in the soil and in the plant
4. Healthy root system

# Drainage



Add OGM



# Soil Fertility Management

## Needed

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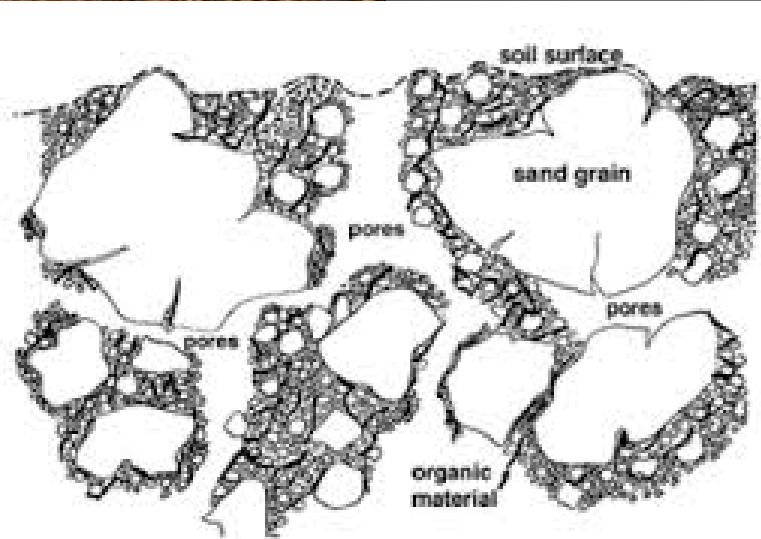
# Drainage



Add OGM

# Soil Fertility Management

## Needed



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2. Nutrients in available forms
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# Drainage



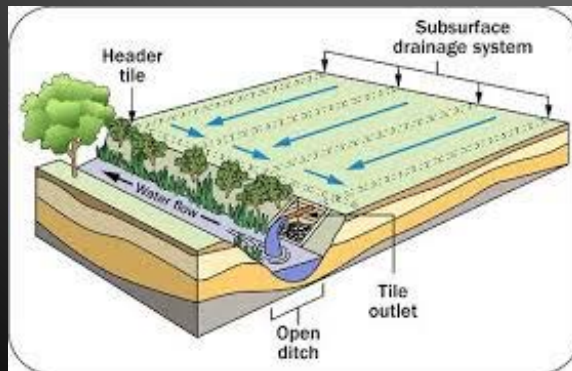
# Soil Fertility Management Needed

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4. Healthy root system

# Drainage



Drainage tiles



# Soil Fertility Management Needed

1. Nutrients in the soil in appropriate quantities
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# Soil Fertility Management

Know about your soil

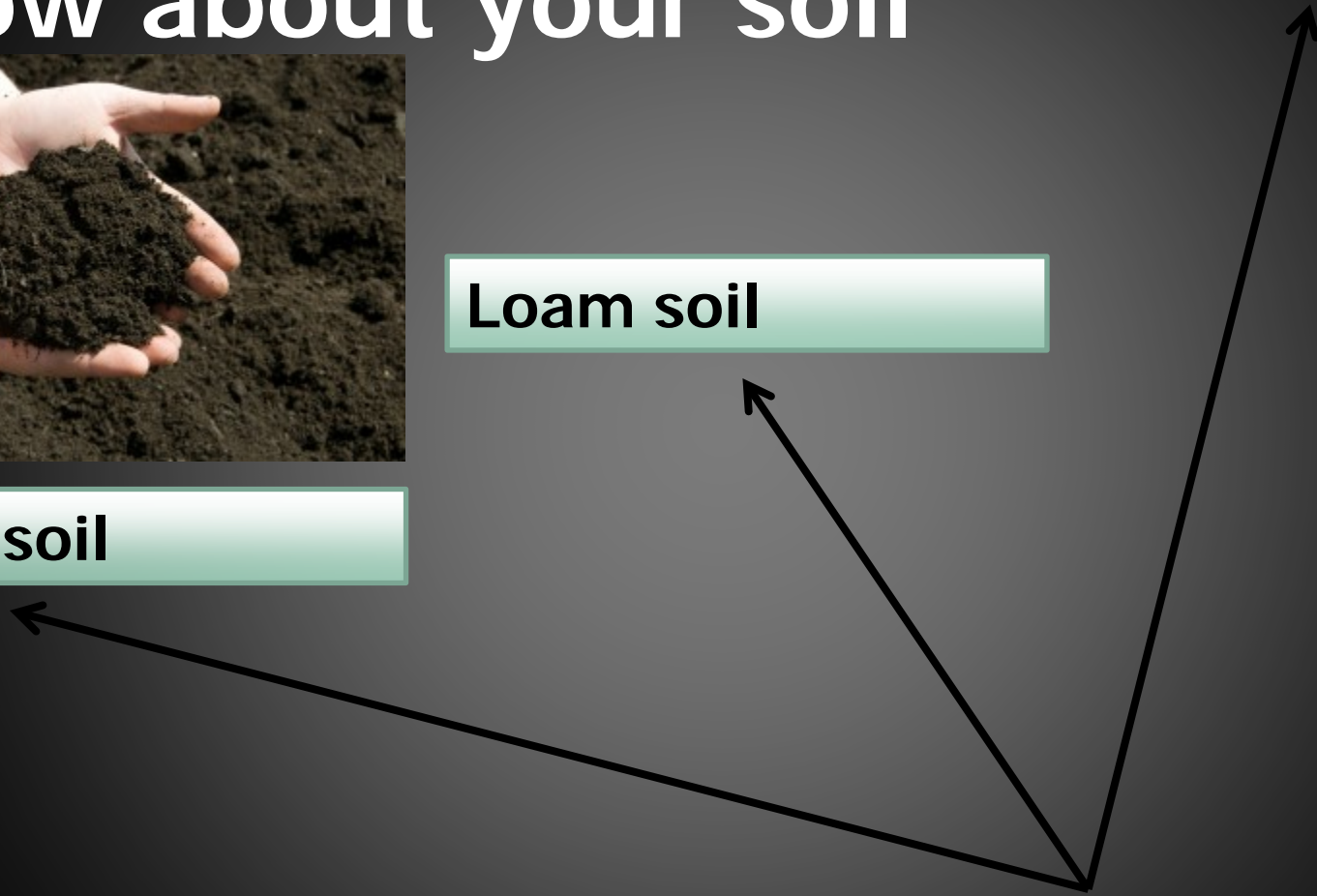


Loam soil

Sandy soil

Clay soil

Soil Test For Texture



# Soil Fertility Management

## Know about your soil



**Clay soil**

**Loam soil**

### **Sandy soil**

- Too much drainage
- Not fertile
- Acid
- Does not hold nutrients
- Does not hold water

# Soil Fertility Management

## Know about your soil



### Loam soil

### Sandy soil

- Too much drainage
- Not fertile
- Acid
- Does not hold nutrients
- Does not hold water

### Clay soil

- Not enough drainage
- Fertile
- Holds on to nutrients
- Alkaline
- Holds too much water



# Soil Fertility Management

## Know about your soil



### Clay soil

- Not enough drainage
- Fertile
- Holds on to nutrients
- Alkaline
- Holds too much water

### Loam soil

- Good drainage
- Fertile
- Holds on to nutrients
- Holds water well

### Sandy soil

- Too much drainage
- Not fertile
- Acid
- Low CEC
- Does not hold water

# Soil Fertility Management

## Work with your soil



### Sandy soil

- Too much drainage → Add organic matter
- Not fertile → Add OGM + Fertilizers
- Acid → Add Lime
- Low CEC → Add organic matter
- Does not hold water → Add organic matter

# Soil Fertility Management

## Work with your soil



### Clay soil

- Bad drainage → Add OGM + Raised beds
- Fertile → Add OGM + (Fertilizers)
- High CEC → Add OGM
- Alkaline → Add Sulfur
- Holds too much water → Add OGM + Raised beds

# Soil Fertility Management

## Work with your soil

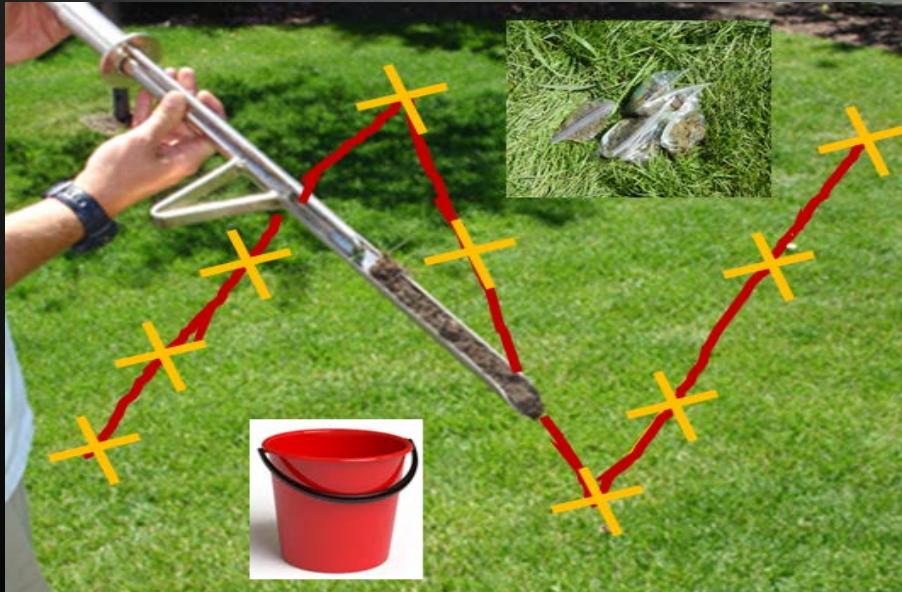


### Loam soil

- Good drainage → Add organic matter
- Fertile → Add OGM + Fertilizers
- High CEC → Add OGM
- Holds water well → Add organic matter

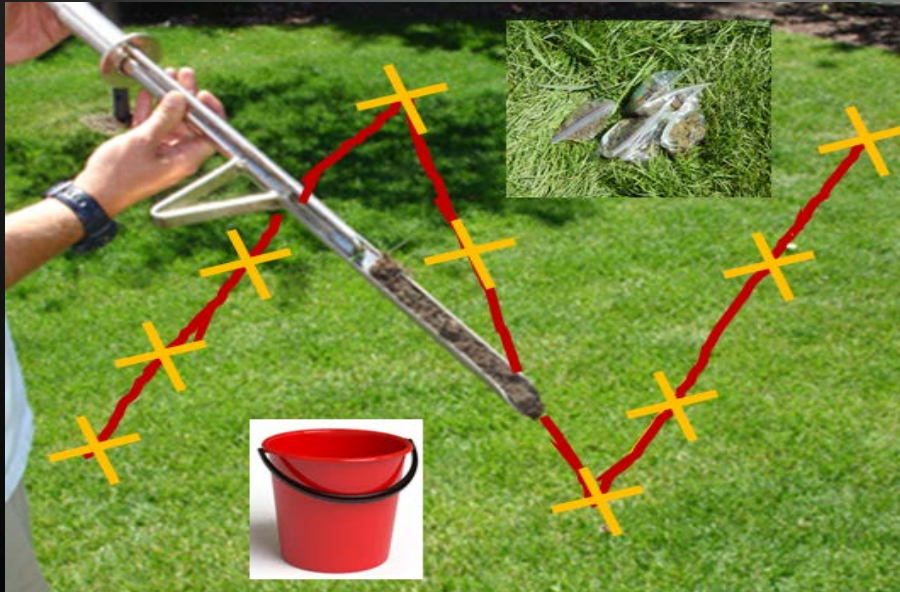
# Soil Fertility Management

Continue to know about



# Soil Fertility Management

Continue to know about



- Fertilize
- Adjust the pH
- Address drainage
- Add organic matter