

ESSENTIAL PLANT NUTRIENTS

- 16 ESSENTIAL PLANT NUTRIENTS
3 FROM WATER AND CO₂
13 FROM THE SOIL
- C HOPKINS CAFÉ MIGHTY GOOD, BUT MANY MORE PREFER CLARA'S ZANY CUP

CLASSIFICATION

<u>STRUCTURAL</u>	<u>PRIMARY</u>	<u>MAJOR</u>	<u>SECONDARY</u>
Carbon	Nitrogen		Calcium
Hydrogen	Phosphorus		Magnesium
Oxygen	Potassium		Sulfur
<u>MICRO</u>			
	Iron		
	Manganese		
	Copper		
	Zinc		
	Boron		
	Molybdenum		
	Chlorine		

- OTHERS HAVE BEEN SUGGESTED
Co, Na, V, Si
- REQUIREMENT FOR ESSENTIALITY
 1. PLANT NEEDS TO COMPLETE LIFE CYCLE
 2. DIRECTLY INVOLVED IN METABOLISM
 3. NO OTHER ELEMENT CAN SUBSTITUTE FOR IT
 4. NEEDED BY A WIDE RANGE OF PLANTS

RELATIVE NUMBER OF ATOMS IN HEALTHY ALFALFA

H	60,000,000	S	30,000
C	35,000,000	Cl	3,000
O	30,000,000	B	2,000
N	1,000,000	Fe	2,000
K	250,000	Mn	1,000
Ca	125,000	Zn	300
Mg	80,000	Cu	100
P	60,000	Mo	1

ESSENTIAL ELEMENTS ABSORBED IN IONIC FORM (P. 68)

ELEMENT	ABSORBED FORM
N	NO_3^- , NH_4^+
P	HPO_4^- , H_2PO_4^-
K	K^+
Ca	Ca^{++}
Mg	Mg^{++}
S	$\text{SO}_4^{=}$
Zn	Zn^{++}
Mn	Mn^{++}
Fe	Fe^{++} , Fe^{+++}
Cu	Cu^{++}
B	H_2BO_3^-
Mo	$\text{MoO}_4^{=}$
Cl	Cl^-

HOW ARE NUTRIENTS ABSORBED BY PLANTS

- PLOW LAYER ROOT VOLUME IS SMALL

CORN = 0.4 %

OAT = 0.6 %

SOYBEAN = 0.9 %

KY BLUEGRASS = 2.8 %

ROOT HAIRS INCREASE SURFACE AREA

NUTRIENTS DELIVERED TO ROOTS BY THREE PROCESSES

- DIFFUSION = MOVEMENT DOWN A CONCENTRATION GRADIENT FROM HIGH TO LOW CONCENTRATION

MOST - P, 75 % K, 25 % N

MOST - Fe, Mn, Zn, Cu

- MASS FLOW = MOVEMENT IN THE WATER BEING DRAWN BY PLANT TRANSPIRATION

25 % K, 75% N,

MOST Ca, Mg, S

MOST - B, Mo, Cl

- ROOT INTERCEPTION = NUTRIENTS ENCOUNTERED BY THE ROOT AS IT EXTENDS THROUGH THE SOIL

VERY SMALL AMOUNTS OF ALL NUTRIENTS

NUTRIENT UPTAKE BY PLANTS

- < NUTRIENT MUST PASS FROM SOIL SOLUTION INTO XYLEM (VESSEL CONDUCTING UPWARD)
- < ACTIVE PROCESS = ENERGY REQUIRED (PUMPS)
- < PASSIVE PROCESS = DOWN CHANNELS ALONG ELECTROCHEMICAL GRADIENT

DEFICIENCIES OF PLANT NUTRIENTS CAUSE SYMPTOMS

- < MOBILE NUTRIENT DEFICIENCIES SHOW ON THE OLDER, LOWER LEAVES

N, P, K, Mg
COMMON CROP SYMPTOMS
- < IM-MOBILE NUTRIENT DEFICIENCIES SHOW ON THE NEWER, UPPER LEAVES

Ca, Zn, B, Mn
DEFICIENCIES OF OTHERS ARE VERY RARE
- < SULFUR DEFICIENCY USUALLY SHOWS OVER THE ENTIRE PLANT

SOILS WHERE DEFICIENCIES CAN BE EXPECTED

N	Zn	Mg
P	Mn	B
K	Fe	S
Ca	Cu	Cl, Mo