Module 7: Plant Nutrition-Fertilizers, Soil pH, Fertility and Organics

LSU AgCenter Home Gardening Certificate Course

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Essential Plant Nutrients

1. A plant cannot complete its life cycle without the element
2. No other element can perform the function of the element
3. The element is directly involved in plant nutrition

Essential Plant Nutrients

Nutrient	Uptake Form	Source	Nutrient	Uptake Form	Source
CARBON	CO_2, HCO_3	Air & Water	boron	H_3BO_3 $H_2BO_3^-$ HBO_3^{2-}	Soil
HYDROGEN	H_2O	Air & Water	chlorine	Cl^-	Soil
OXYGEN	H_2O	Air & Water	copper	Cu^{2+}	Soil
NITROGEN	NO_3^-, NH_4^+	Soil	iron	Fe^{2+}	Soil
PHOSPHORUS	$H_2PO_4^-$ HPO_4^{2-} PO_4^{3-}	Soil	manganese	Mn^{2+}	Soil
POTASSIUM	K^+	Soil	molybdenum	MoO_4^{2-}	Soil
Sulfur	SO_4^{2-}	Soil	zinc	Zn^{2+}	Soil
Calcium	Ca^{2+}	Soil			
Magnesium	Mg^{2+}	Soil	nickel, silicon, sodium, cobalt	Ni^+ Si^+ Na^+ Co^{2+}	Soil

ALL CAPS=Primary MacroNutrients First Letter Cap=Secondary Macronutrients all lowercase=micronutrients

Principle Plant Constituents

Element	Dry Weight
CARBON	45%
HYDROGEN	45%
OXYGEN	6%

Primary & Secondary Macronutrients

Element	Dry Weight
NITROGEN	1.5%
PHOSPHORUS	0.2%
POTASSIUM	1.0%
Calcium	0.5%
Magnesium	0.2%
Sulfur	0.1%

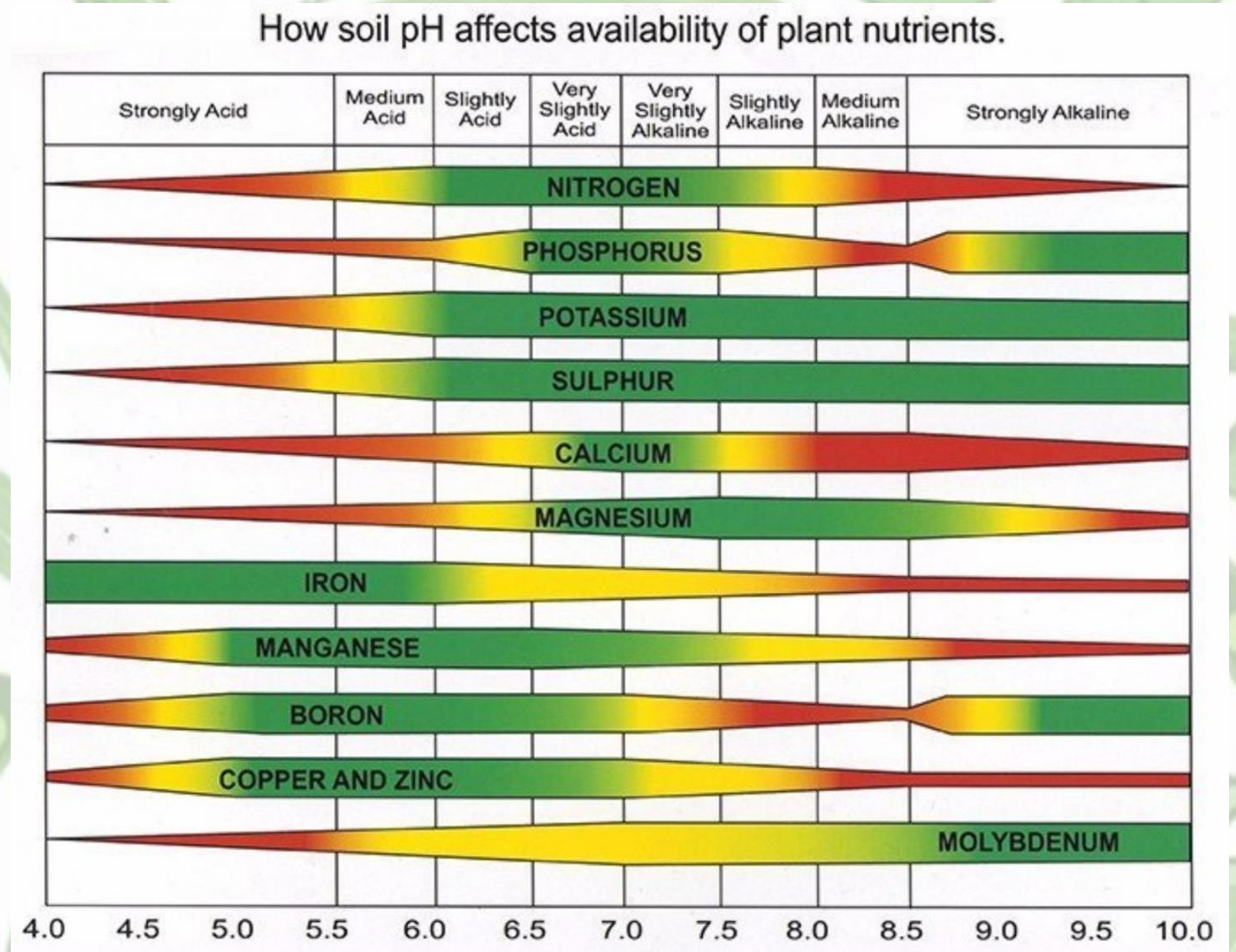
Micronutrients

Element	Dry Weight
chlorine	0.01%
iron	0.01%
manganese	0.005%
boron	0.002%
zinc	0.002%
copper	0.0006%
molybdenum	0.00001%
nickel, cobalt, sodium, silicon, vanadium	?? – A few plants

Nutrients From A Plant's Eye View

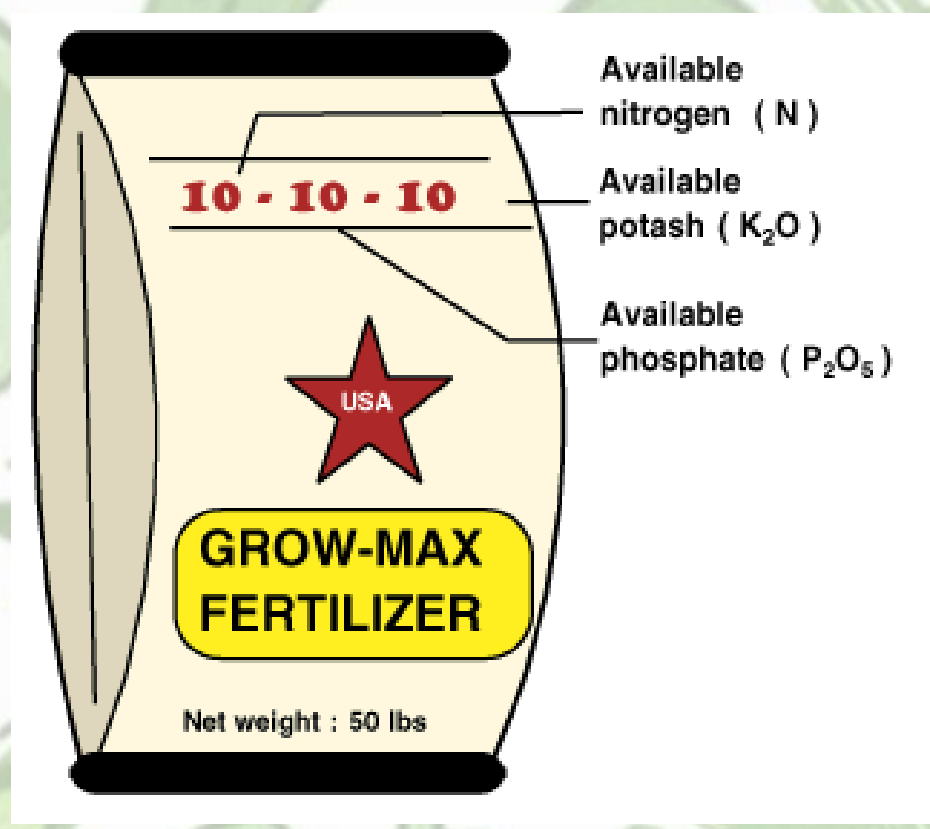
1. Plants can only take up nutrients in specific forms (earlier table)
2. A plant doesn't care if nitrogen is from NH_4NO_3, blood meal or cow manure
3. Organic material must be converted to proper ionic forms by microorganisms

Soil pH and Soil Nutrients



Fertilizers – Understanding the Label

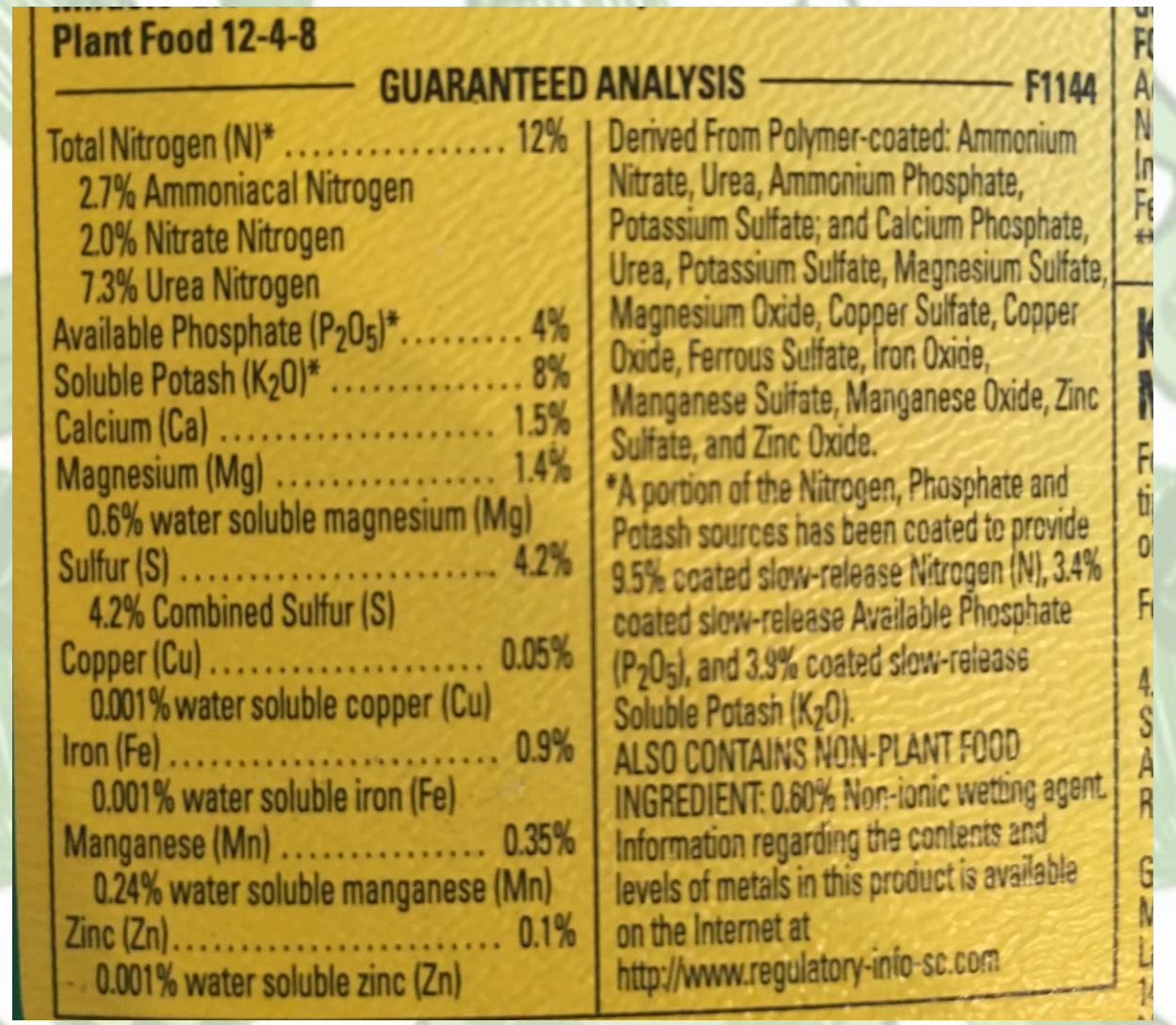
1. ALL fertilizer labels have three bold numbers, national standard
2. The first number is the % amount of nitrogen (N),
3. The second number is the % amount of phosphate (P_2O_5)
4. The third number is the % amount of potash (K_2O)
5. Always three numbers even if one or more are 0



Fertilizer Labels

1. “Balanced Fertilizer” – term used to describe a fertilizer where all numbers are equal (10-10-10, 8-8-8, 13-13-13)
2. Fertilizer application rates are always given in pounds per unit area of N, P_2O_5 and K_2O

Fertilizer Labels



Plant Food 12-4-8

GUARANTEED ANALYSIS — F1144

Total Nitrogen (N)*	12%
2.7% Ammoniacal Nitrogen	
2.0% Nitrate Nitrogen	
7.3% Urea Nitrogen	
Available Phosphate (P_2O_5)*	4%
Soluble Potash (K_2O)*	8%
Calcium (Ca)	1.5%
Magnesium (Mg)	1.4%
0.6% water soluble magnesium (Mg)	
Sulfur (S)	4.2%
4.2% Combined Sulfur (S)	
Copper (Cu)	0.05%
0.001% water soluble copper (Cu)	
Iron (Fe)	0.9%
0.001% water soluble iron (Fe)	
Manganese (Mn)	0.35%
0.24% water soluble manganese (Mn)	
Zinc (Zn)	0.1%
0.001% water soluble zinc (Zn)	

Derived From Polymer-coated: Ammonium Nitrate, Urea, Ammonium Phosphate, Potassium Sulfate; and Calcium Phosphate, Urea, Potassium Sulfate, Magnesium Sulfate, Magnesium Oxide, Copper Sulfate, Copper Oxide, Ferrous Sulfate, Iron Oxide, Manganese Sulfate, Manganese Oxide, Zinc Sulfate, and Zinc Oxide.

*A portion of the Nitrogen, Phosphate and Potash sources has been coated to provide 9.5% coated slow-release Nitrogen (N), 3.4% coated slow-release Available Phosphate (P_2O_5), and 3.9% coated slow-release Soluble Potash (K_2O).

ALSO CONTAINS NON-PLANT FOOD INGREDIENT: 0.60% Non-ionic wetting agent.

Information regarding the contents and levels of metals in this product is available on the Internet at http://www.regulatory-info-sc.com

Fertilizer labels will also give a more detailed “Guaranteed Analysis” as well as the source of the various nutrients in a smaller table somewhere on the label.

Fertilizer Terminology

1. Organic - Plant, animal, or mineral remains that are packaged and sold either in their raw state or as pellets with little to no processing.
2. Chemical/Synthetic - formulated with chemically processed compounds although many of them come from naturally occurring mineral deposits.

Plant Nutrient Deficiencies

Abiotic Disorder - Abnormality in a plant that is not caused by a living organism or pest.

1. Nutrient Deficiency
2. Pesticide Injury
3. Weather Related
4. Mechanical Injury
5. Excess or Insufficient Water
6. Fertilizer Burn
7. Genetic Abnormalities

Plant Nutrient Deficiencies - N

Protein/amino acids, chlorophyll, cell formation

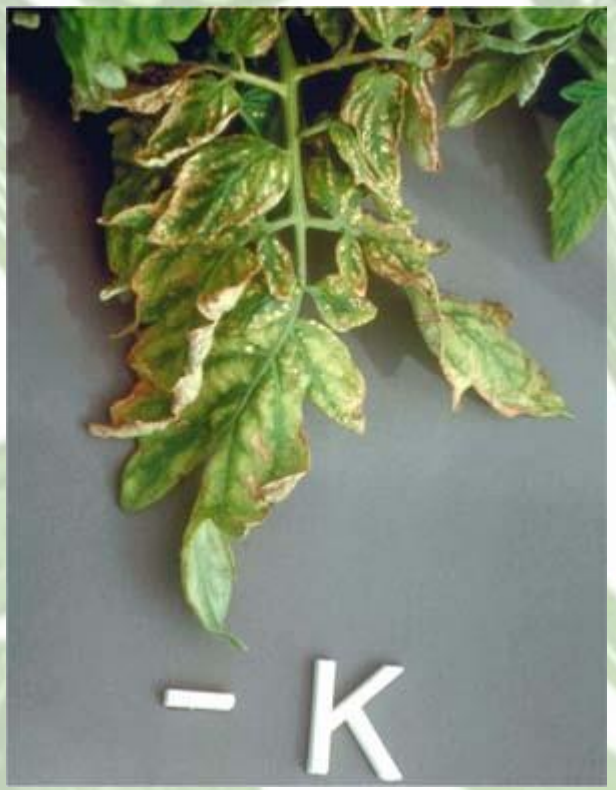
Plants light green with leaves light green or yellow; no necrotic spotting. Older leaves first.

Plant Nutrient Deficiencies - P

Cell formation, protein syntheses, fat and carbohydrate metabolism

Plants dark green, often developing purple or red color. Older leaves first.

Plant Nutrient Deficiencies - K



Water regulation,
enzyme activity

Effects mostly localized; No interveinal chlorosis; chlorotic areas with a burning of leaf margins; spotting sometimes along leaf margins. Older leaves first.

Plant Nutrient Deficiencies - S

Protein, amino acid, vitamin and oil formation

Chlorosis without interveinal chlorosis. Young leaves light green; typically no chlorotic spotting or striping.

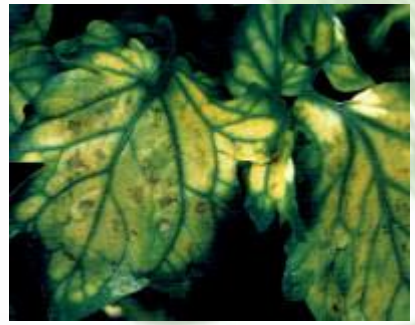
Plant Nutrient Deficiencies -Ca

Root permeability, enzyme activity

Growing point (terminal bud) dies. Young leaves of terminal bud typically hooked at first, finally turning brown and dying back

Plant Nutrient Deficiencies - Mg

Chlorophyll, fat formation and metabolism



Effects mostly localized; Chlorosis with interveinal chlorosis; leaves sometimes red or with dead spots. Older leaves first.

Plant Nutrient Deficiencies - Fe

Enzyme development and activity

Young leaves with interveinal chlorosis; Sharp distinction between veins and chlorotic areas.

Plant Nutrient Deficiencies - Mn

Enzyme activity and pigmentation

Young leaves with interveinal chlorosis; No sharp distinction between veins and chlorotic areas; spotty appearance.

Plant Nutrient Deficiencies - Cu

Enzyme activity

Chlorosis of young leaves; tips appear withered and will eventually die

Plant Nutrient Deficiencies - B

Enzyme activity

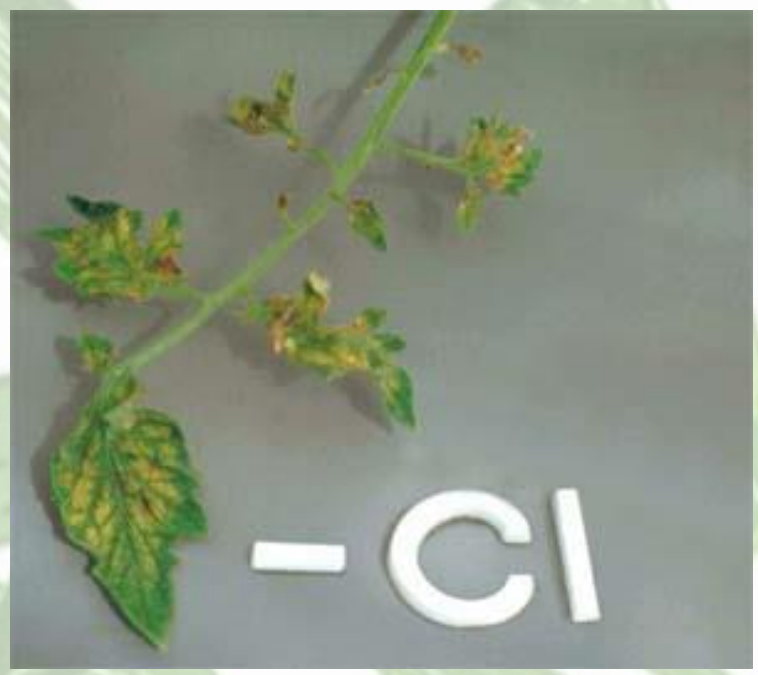
Growing point (terminal bud) dies. Young leaves of terminal bud become light green at bases; leaves become twisted and brittle and die back at growing point; chlorosis of young leaves

Plant Nutrient Deficiencies - Mo

Enzyme activity and nitrogen fixation in legumes

Plants light green; necrotic spotting on leaves; pale leaves sometimes scorched, cupped or rolled. Older leaves first.

Plant Nutrient Deficiencies - Cl



Chlorophyll formation, enzyme activity, cellular development

No interveinal chlorosis; distinct chlorotic and necrotic lesions (spotting) with abrupt boundary between dead and live tissue. Younger leaves first.

Plant Nutrient Deficiencies - Zn

Enzyme activity

Middle leaves with interveinal chlorosis; stunted growth. Initial symptoms occur in middle leaves, with young and/or old leaves becoming chlorotic in later stages of deficiency.

Advantages of Organic Fertilizers

1. Organic fertilizers provide plant nutrients as they break down;
2. They improve the structure of the soil and increase its ability to hold water and nutrients.
3. Improve the diversity and population of beneficial microbiota
4. They are the slow-release fertilizers, harming plants by over fertilization is reduced
5. Reduced risk of toxic buildups of chemicals and salts harmful to plants.
6. Organic fertilizers are renewable, biodegradable, sustainable, and environmentally friendly.

Advantages of Chemical Fertilizers

1. Nutrients are available to the plants immediately, improvement occurs in days.
2. They are highly analyzed to produce the exact ratio of nutrients desired.
3. Standardized labeling makes ratios and chemical sources easy to understand.
4. They’re inexpensive.

Disadvantages of Organic Fertilizers

1. Microorganisms are required to break down and release nutrients into the soil. Since they need warmth and moisture to do their job, the effectiveness of organic fertilizer is limited seasonally.
2. Organic fertilizers break down according to nature's rules, so they may not release nutrients as soon as you need them - you won't see improvement overnight.
3. Nutrient ratios are often unknown, and the overall percentage is lower than chemical fertilizers.
4. Often more expensive.

Disadvantages of Chemical Fertilizers

1. Chemical fertilizers are primarily made from nonrenewable sources, including fossil fuels.
2. They provided plant nutrients but do nothing to sustain the soil.
3. Many chemical fertilizers do not provide trace elements.
4. Because the nutrients are readily available, there is a possibility of over fertilization that can injure plants.
5. Chemical fertilizers tend to leach, or filter away from the plants, requiring additional applications.
6. Long-term use of chemical fertilizer can change the soil pH, effect beneficial microbial ecosystems

Organic Fertilizer N-P-K Values

Organic Nutrient Source	N-P-K	Rate of Availability
Colloidal Phosphate	0-25-0	Slow
Greensand	0-1.35-(4-9.5)	Very Slow
Rock Phosphate	0-(20-32)-0	Very Slow
Bone Meal	(1-4)-(18-34)-0	Medium
Compost	(1.5-3.5)-(0.5-1)-(1-2)	Slow
Coffee Grounds	2-0.4-0.7	Slow
Cottonseed Meal	6-2.5-1.7	Medium
Blood Meal	12-1.5-0.5	Medium
Fish Emulsion	5-2-2	Rapid
Fish Meal	14-4-0	Slow
Guano	5.7-8.6-2	Medium
Worm Castings	1.5-2.5-1.3	Medium
Composted Manures	(0.5-4)-(0.5-3)-(0.5-3)	Medium
Compost Tea	0.07-0.02-0.05	Rapid

Benefits of Composting and Compost

1. Increases soil moisture holding capacity and CEC
2. Can suppress plant diseases and pests through competition or direct action.
3. Reduces the need for chemical fertilizers.
4. Encourages the production of beneficial bacteria and fungi that break down organic matter.
5. Reduces landfill input. Food scraps and yard waste together currently make up more than 28 percent of what we throw away.

What goes in your backyard compost?

CARBON MATERIALS (Browns)

Shredded cardboard

Dryer and vacuum cleaner lint

Crushed egg shells

Fireplace or wood ash (no coal ash)

Hay and straw

Pinestraw (small amounts)

Nut shells

Household plants and used potting soil

Old brush, shrub trimmings and prunings

Paper towels and towel rolls

Saw dust and wood chips (untreated)

Shredded newspaper

Yard trimmings (dry leaves, clippings and twigs)

NITROGEN MATERIALS (Greens)

Bread & grains

Coffee grounds & paper filters

Fruits (cooked or uncooked – limit citrus)

Green grass clippings

Green leaves

Green shrub prunings

Hair and fur

House plants

Kelp or seaweed

Manure from chickens, rabbits, cows, horses (herbivores)

Old flowers

Tea bags (with tags)

Vegetables (cooked or uncooked)

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