



# FERTILIZERS

Nitrogen up to leaves and shoots  
Phosphorus down into the roots  
Potassium for health all around

2019 Master Gardener Training Class  
Emily Gianfortoni, Hanover Master Gardener



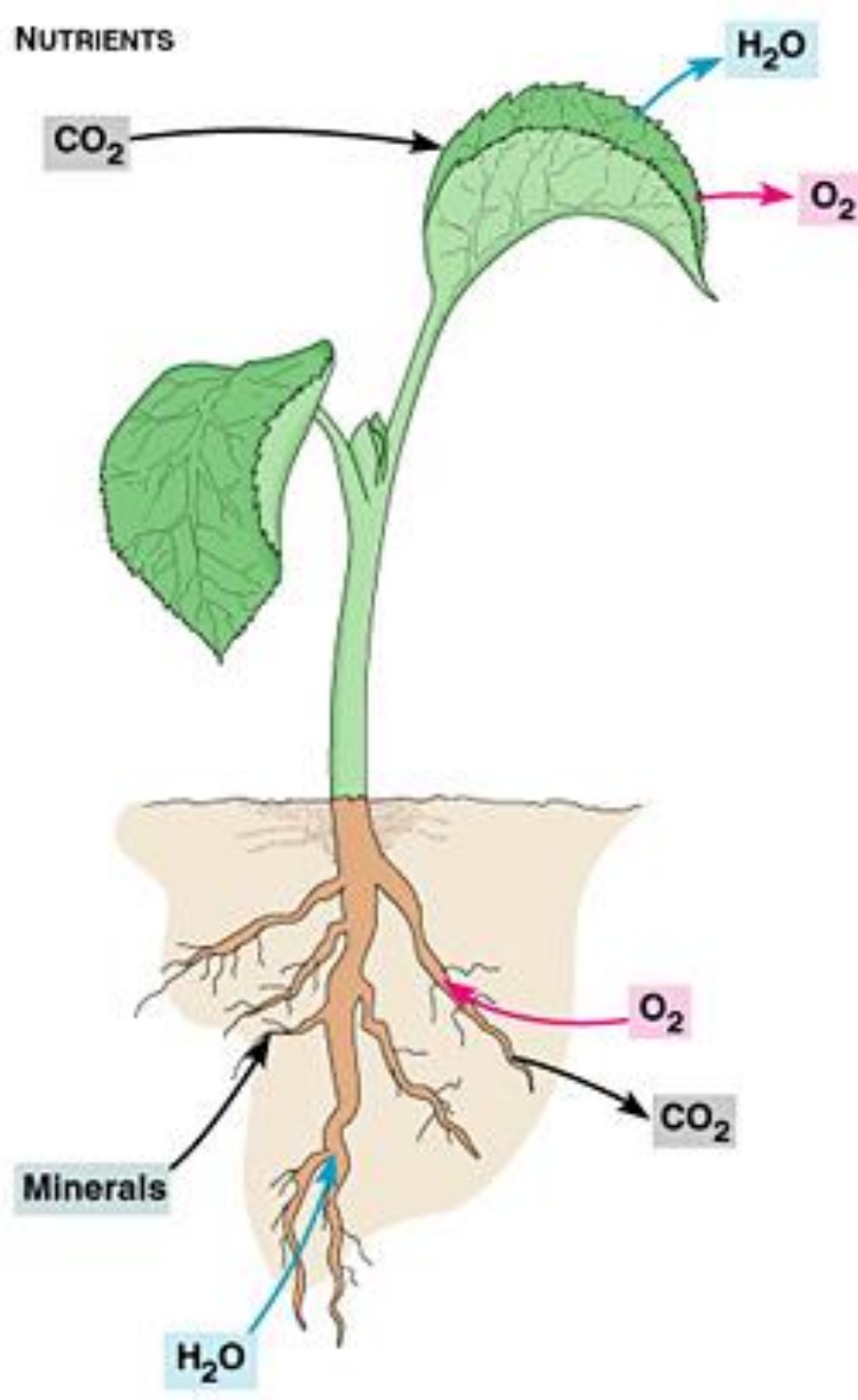
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# **Life Depends on Plants**

- **Plants unique among almost all other organisms on earth**
- **Can manufacture or synthesize own food (sugars and carbohydrates) from carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) in the presence of light (sun).**
- **Simple sugars composed of carbon, hydrogen and oxygen**



# How do plants get the elements they need to photosynthesize and grow?

- Three essential elements: C, H, O
- Carbon dioxide through stomates in leaves
- Water and oxygen through roots

# **To grow plant needs other elements**

- **To produce proteins plants need nitrogen (N), sulfur (S) and other elements**
- **To manufacture chlorophyll need N, magnesium (Mg), and iron (Fe)**
- **Other elements needed for enzymes, plant hormones, and other functions**



# Essential Elements for Plant Growth

- **Major Elements (macronutrients)**
  - N - Nitrogen
  - P - Phosphorus
  - K - Potassium
  - Ca - Calcium
  - Mg - Magnesium
  - S - Sulfur



# Essential Elements for Plant Growth

- **Minor Elements**

- Fe - Iron
- Cu - Copper
- Zn - Zinc
- Mn - Manganese

- \* not listed in all sources

- **(Micronutrients)**

- MB - Molybdenum
- Ni – Nickel\*
- Cl - Chlorine
- Co – Cobalt\*
- B - Boron

# How Plants Take Up Elements From Soil

- 90% of plant species associated with root fungi
- Mycorrhizal = mutual relationship between roots and fungi





- **Mycorrhizae penetrate root hairs**
- **Make water and nutrients more available to plant**
- **Receive sugars & carbohydrates from plant**

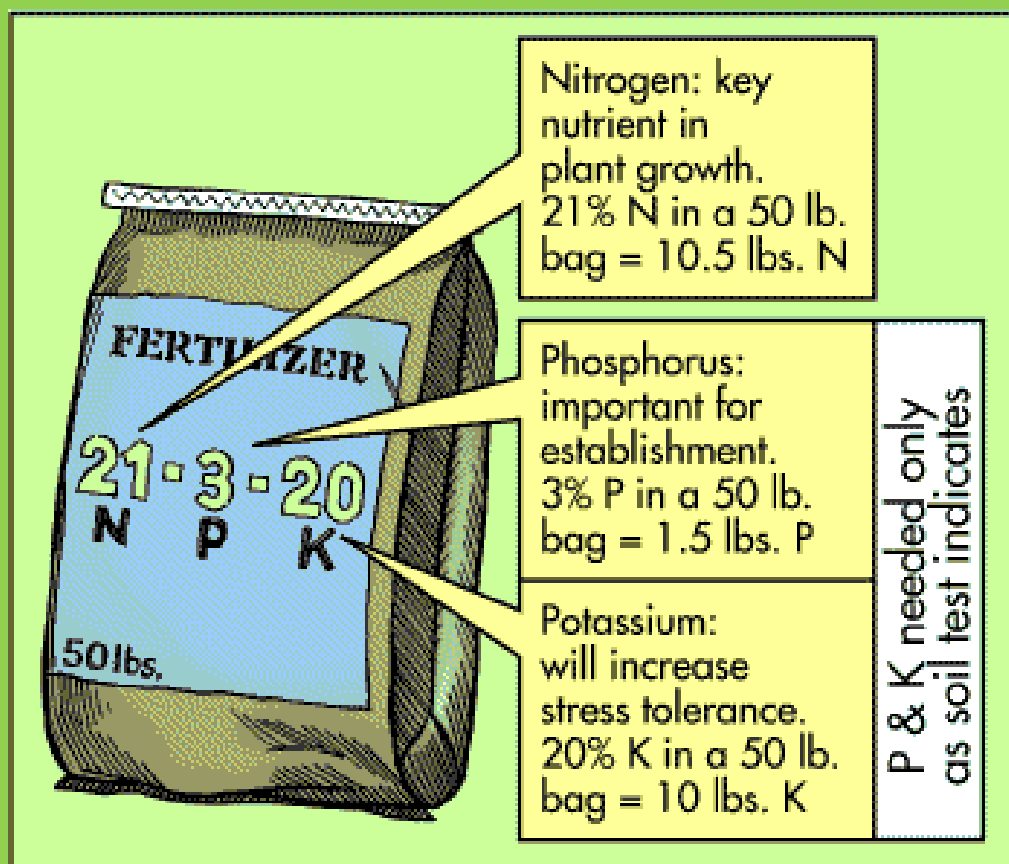


# **Fertilizers**

**Some reasons to use:**

- **Increase productivity of plants such as vegetables**
- **Improve health of plant**
- **Supplement elements that are low (after soil testing)**

# Required: prominent display of percentage by weight of 3 major elements on packaging



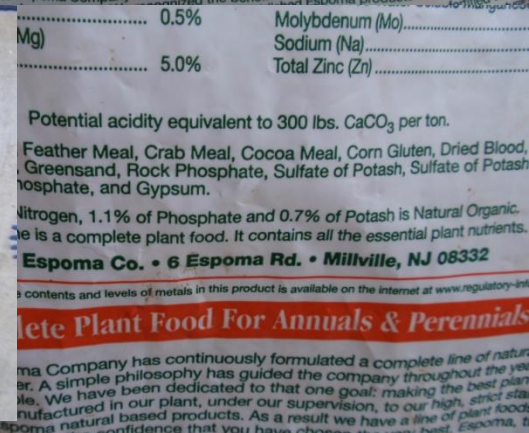
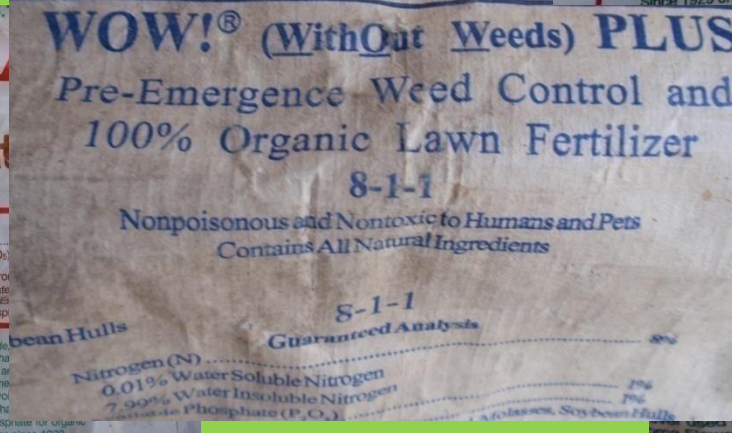
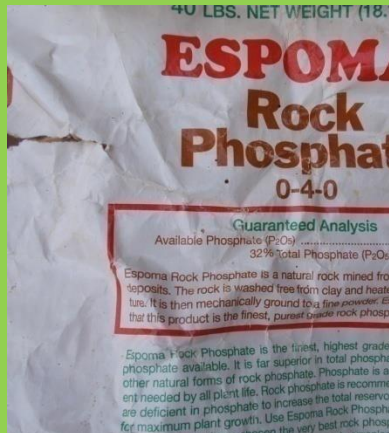
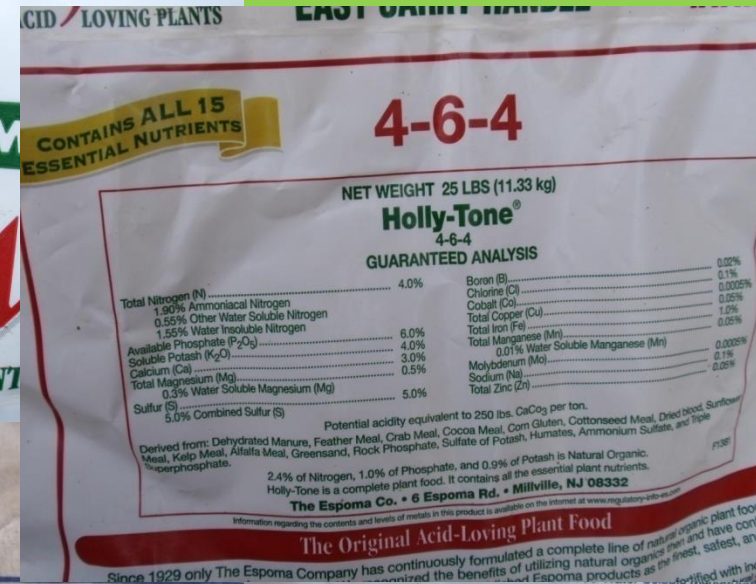
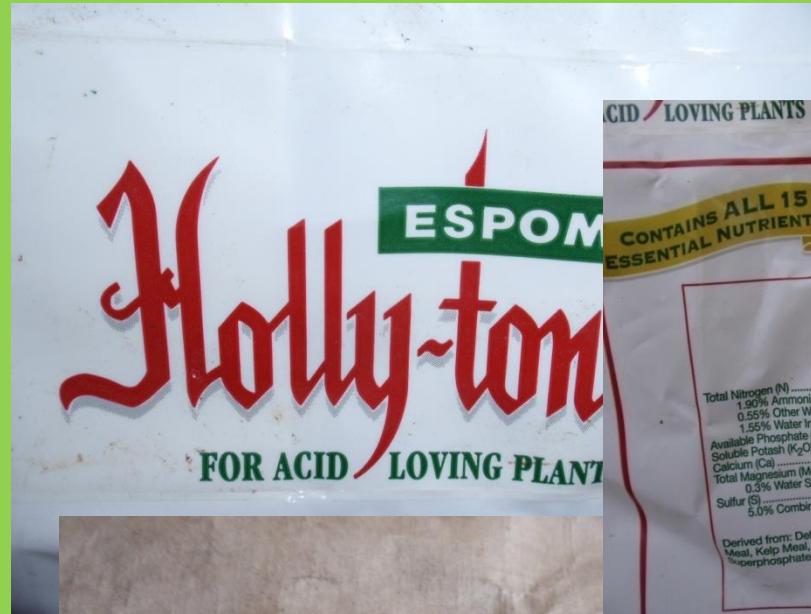
**N - nitrogen**

**P - phosphate  
( $P_2O_5$ )**

**K – potash  
( $K_2O$ )**

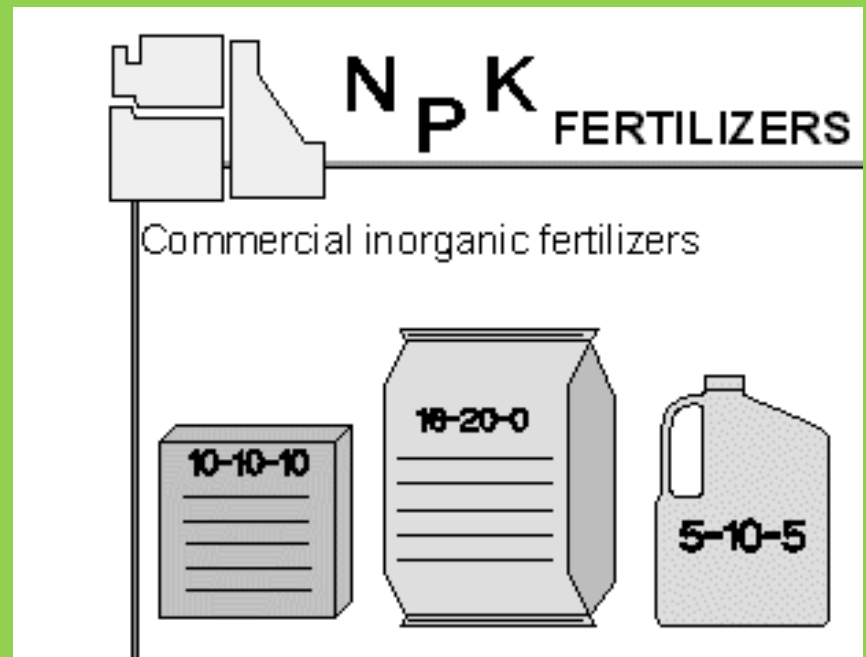
# Types of Fertilizers

- Synthetic (chemical)
- Organic
- Complete
- Incomplete





# Synthetic (chemical or inorganic)





# **Synthetic Fertilizers**

- **Most are in the form of salts**
- **Act more quickly making elements readily available**
- **Because are salts, can "burn" plants**
- **Can be detrimental to soil microorganisms**
- **Urea is a synthetic organic fertilizer manufactured from inorganic materials**

# Organic Fertilizers



# Organic Fertilizers

- Elements are from once-living organisms
- Depend on soil microorganisms to break them down and reduce to elements
- Therefore are mostly water insoluble (WIN) and break down slowly
- Have lower quantity of necessary elements than synthetic fertilizers
- Improve soil quality and increase bacteria and fungi, especially the mycorrhiza
- Micorrhizal fungi make elements more available to plants

# Earthworm Castings 1-0-0

- 0.1% N (water soluble)
- 0.9% N (water insoluble)
- 0.2% Fe (iron)



# Complete and Incomplete

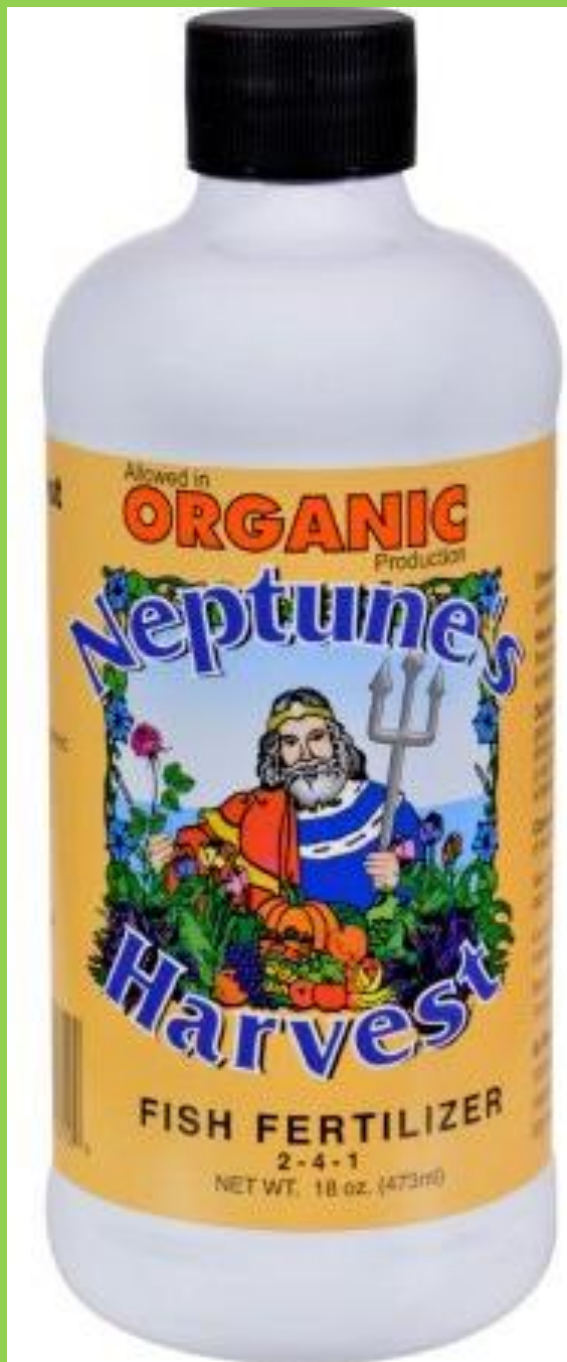
- **Complete** when contains N P and K
- **Incomplete** contains one or two of N P or K
- **Incomplete** useful when soil tests show one or two of the elements to be very high and other(s) low
- **Note:** complete doesn't mean all major and minor elements included



# Complete Synthetic: Colorburst Flowering Plant Food 15-30-15

- 11.7% ammoniacal N
- 3.3% urea (polymer coated)
- 30% available phosphate
- 15% soluble potash





- # Complete Organic
- ## Neptune's Harvest
- 2-4-1 fish fertilizer
  - Allowed for organic production
  - Made from N. Atlantic fish and seaweed

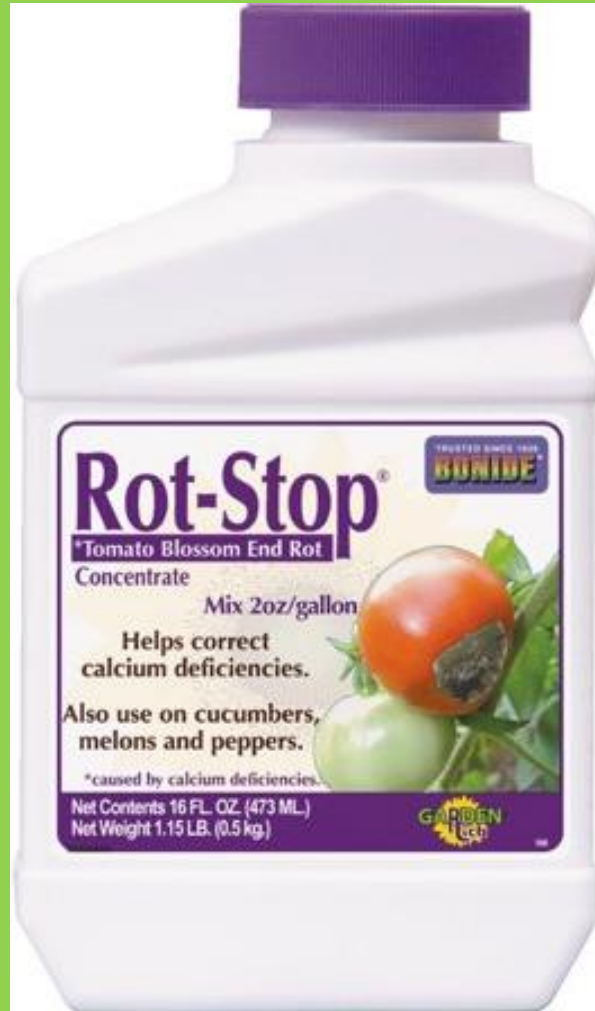
# Incomplete Organic Organic Seaweed Concentrate 0-4-4

- 4% phosphoric acid
- 4% soluble potash
- A soluble seaweed extract to be used as foliar spray or soil drench



# Incomplete Synthetic

## Rot Stop: Calcium Chloride



- Sold as a treatment for blossom end rot on tomatoes
- Foliar spray to correct calcium deficiency

# Minerals

- **Inorganic but naturally occurring**
- **Examples:**
  - **Greensand (source of potassium)**
  - **Rock phosphate (source of phosphorus)**
  - **Dolomitic limestone (calcium and magnesium)**



# **Green sand 0-0-3 (iron-potassium silicate)**



- **Mined from sedimentary rock deposits**
- **3% potash from iron-potassium silicate**
- **Also includes iron, magnesium, silica and other trace minerals**

# Muriate of potash

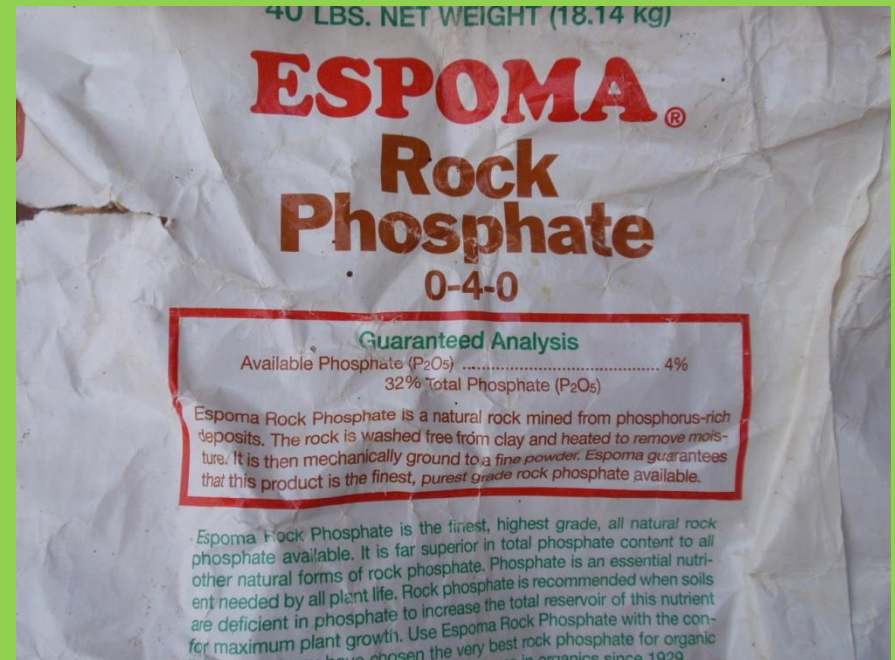
## 0-0-60

- 60% soluble potash
- Is the chemical compound potassium chloride
- Extracted from mineral sylvite or manufactured



# Rock Phosphate 0-4-0

- Natural rock mined from phosphorus rich deposits, ground, washed to remove clay, and heated to remove moisture)
- Problem: not a renewable resource



# Fertilizer Formulations

## Granulated or dry

- Most common type
- Formulations sold for different types of plants, (mostly marketing); read label



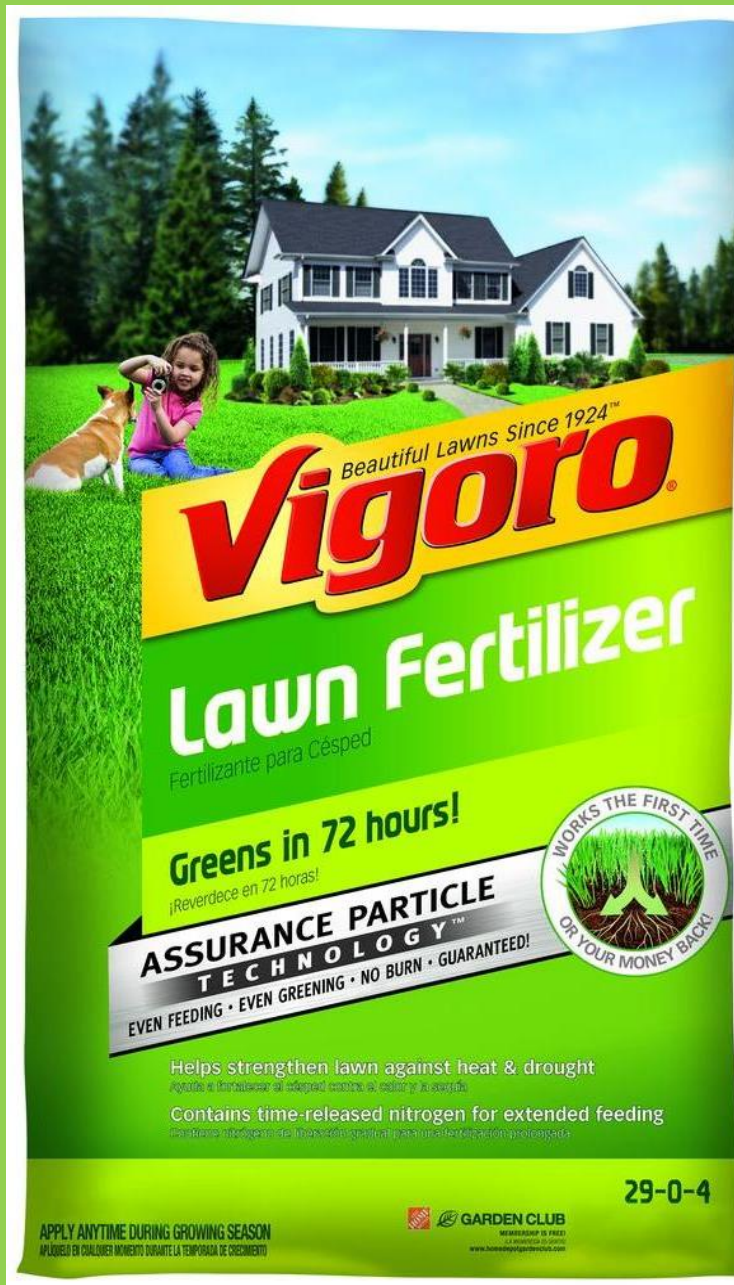
# Espoma Plant Tone 5-3-3

- Granular
- Derived from: hydrolyzed feather meal, pasteurized poultry manure, cocoa meal, bone meal, alfalfa meal, greensand, humates, sulfate of potash and sulfide of potash magnesium





# Granular Lawn Fertilizers



# Liquid or water soluble

- Best for annuals, vegetables, container plants
- Gives plant a quick boost, but not good for soil microorganisms



# Miracid Soil Acidifier Plant Food

## 30-10-10

- Water soluble
- Also contains less than 1% of
  - B (boron)
  - Cu (chelated copper)
  - Fe (chelated iron)
  - Mn (chelated manganese)
  - Mb (molybdenum)
  - Zn (chelated zinc)





## Polymer coated



- Slow release because coated with a polymer that responds to soil temperatures & water
- Most slowly release elements over 3 or 4 months
- Have been formulated for different types of plants (e.g. vegetables, acid loving)

# Osmocote Slow Release 9-6-6

**For azaleas and rhododendrons with soil acidifiers**

- **Ammoniacal N – coated**
- **Nitrate N**
- **Phosphate – coated**
- **Soluble potash – coated**
- **Sulfur**
- **Iron water soluble – coated**



# Foliar

- Soluble in water; sprayed on plant
- Elements quickly absorbed by plant
- But only to be used as supplement





# Fertilizer Take Away Points If You Use Chemical Fertilizers



- **Test soil before applying fertilizer**
- **Excess P and N in runoff pollute streams and Chesapeake Bay**
- **Apply correct ratio of N-P-K according to soil test**
- **WIN (water insoluble) and slow release best for shrubs, lawns, perennials**
- **Water soluble fertilizers can be used for annuals, some vegetables, containers**
- **Many potting soils contain slow release polymer coated fertilizer**

# Alternative to Synthetic Fertilizers

- Use organic WIN fertilizers
- Let the microorganisms do the work
- Read *Teaming with Microbes*



# A Few Take Away Points



- Use compost and organic materials to improve soil and build population of bacteria and fungi
- Use synthetic fertilizers in recommended amounts only after soil testing (as salts can kill microorganisms)

- **If you kill the soil bacteria and fungi, you must continue to fertilize with synthetic fertilizers**
- **To restore soil bacteria and fungi use compost, composted mulches and compost tea**
- **Humates (acids remaining at the end of composting process) can improve soil quality (example Rich Earth brand)**



# Before Applying Fertilizer or Amendments: Don't Guess, Soil Test



## Why test your soil?

- To determine fertilizer needs so that correct type and amount can be applied
- To measure pH (acidity) of soil so that it can be corrected for type of plant to be grown



# **Plants that don't need annual fertilizing**

- **Trees: receive nutrients from fallen leaves, mulch & native soil**
- **Herbs: too much fertilizer or organic matter may lower content of essential oils**
- **Shrubs: if growth slow, top dress with compost or use balanced fertilizer at appropriate time**

# **Plants that benefit from fertilizer**

- Annuals & bedding plants: polymer coated or other slow release fertilizers, especially if dead plant material is removed in fall**
- Vegetables: balanced fertilizer should be incorporated into top 6 in. of soil before planting**
- House plants: use dilute liquid fertilizer only during spring & summer months**

# Questions?

