Quality vegetables require high levels of minerals and water.
They grow rapidly and produce their edible portion in 25–100 days
Six foot tall corn has to grow an inch per day
An 1100 pound pumpkin gains more than ten pounds per day
We want tender, crisp vegetables with succulent, tasty fruits
Plants that lack water and nutrients are not as productive nor as tasty.
Follow guidelines for a productive garden of quality vegetables.
Consider a soil test

- If the soil has not been gardened previously
- If the garden performs poorly in spite of your fertility program
- If you suspect salts or high alkalinity problems
The USU Soil Testing Lab will test your soil for $14.00

- It gives pH
- Phosphorus
- Potassium
- Soluble salts
- Soil texture
Other tests are also available

• The website is [http://www.usual.usu.edu/](http://www.usual.usu.edu/)
• Phone 801-797-2217
• The test will not identify soil home insects, diseases or chemical residue
Fertilizer recommendations differ for gardens and farm crops
You want to grow the best vegetables in the garden space
You need to stimulate early growth to get quality vegetables
You also need to enhance limited root system of a short-season crop

- Transplants and seedlings need to have nutrients available to the small root systems
Home vegetable gardens are not usually large

- For a few dollars you can purchase enough fertilizer to be far more generous than farmers would be
Excess fertilizer can damage plants

- Fertilizers are salts
- Be very cautious with nitrogen and potassium, to avoid damage to roots by excessive salt build-up
- Excess phosphorous reduces the availability of minor elements such as iron, manganese, and zinc
Avoid excess fertilizer

• After lawns, trees and gardens are indiscriminately fertilized for a few years, one or both of these elements may be excessively high.
What Does My Soil Contain?
Most native soils in our area contain high levels of potassium.
Phosphorus content varies but availability is often low
Nutrient Availability

- Factors such as soil alkalinity, temperature and organic matter content and microbial activity will influence whether these elements are available to plants when they need them.
Plants require more nitrogen than other nutrients

- Nitrogen is readily leached from soil and must be applied each year for high yields
Phosphorus and potassium are vital for leaves, stems and roots

- These elements are needed in smaller amounts
All substances sold as fertilizers must have a guaranteed analysis.
This analysis is expressed as a percentage of the fertilizer content

- For example, a 16-16-8 fertilizer contains 16% nitrogen, 16% phosphate (P2O5) and 8% potash (K2O)
- Minor elements used by vegetables are usually in adequate supply in our soils
The fertilizer formula you use depends on what is available here

• Bulk purchases in 20–50 pound bags may be more economical than small boxes of highly specialized individual crop food
Many flowers need the same amounts applied to vegetables
Fertilizer quality does not deteriorate if it is kept dry
When Is It Needed?
Cool weather reduces the nutrient uptake of elements

• This is especially true with phosphorus and potassium
• This means there should be adequate amounts of soluble nutrients available so the young plant can produce early, rapid growth for maximum yields
The first 4-6 weeks is critical for phosphorus and potassium uptake
Nitrogen may be added again later in the season

- Adding phosphorous and potassium later does little good since as the soil warms, they are available in sufficient quantities
Banding Fertilizers

• A small quantity of soluble nutrients at planting time into which roots of young plants can grow will encourage early vigorous growth
Make a trench 3 inches deep with the corner of a hoe
Use $\frac{1}{2}$ cup of a fertilizer such as 16-16-8 per 10 ft. of row

- Form the seed furrow at the proper depth for the vegetable approximately 2 inches above and 2 inches to the side of the fertilizer
- Do not permit the seeds to contact the fertilizer
Banding fertilizer keeps weeds between the rows from nutrients
To fertilize a transplant

- Place 2–3 tablespoons of a fertilizer such as 16-16-8, 4 to 5 inches deep with a trowel or shovel
- About 2–3 inches away, make another hole and set the plant
To fertilize a transplant
Fertilizer may be applied in “spots” for vegetables spaced widely apart

- Plant cucumber or squash seed in a 6–8 inch circle around \( \frac{1}{4} \) cup of fertilizer buried 3–4 inches deep
- Well-rotted manure or compost also may be banded
- Much larger amounts of manure are needed than with commercial fertilizers
Broadcasting Fertilizers

- This method is less efficient but faster to apply than banded fertilizer
- Weeds between the rows will receive just as much as the garden plants!
Broadcasting Fertilizers

• Just prior to planting, uniformly spread 10–12 lbs. of a complete fertilizer such as 16-16-8 per 1,000 sq. ft. and work into the soil surface by raking or rototilling
Broadcasting Fertilizers

16-16-8


NET WT. 50 lbs (22.7 kg)
Mix phosphorous deeply enough to contact moist soil

- It will then be available to plant roots
- It remains wherever placed in the soil
If you’ve added a lot of organic matter for soil improvement

- Add 10 lbs. of ammonium sulfate per 1,000 sq. ft. for each 1 inch depth of sawdust, leaves, straw, etc.
SIDE DRESSING DURING THE SEASON
Supplemental nitrogen may be added a month after planting

• Symptoms include a plant’s pale green or yellow color
• Add $\frac{1}{2}$ cup ammonium sulfate or $\frac{1}{4}$ cup urea per 10 ft. of row
• Repeat this application if corn, pole beans, or other long season crops show a need
Nitrogen leaches readily from well drained, sandy soils

- In sandy soils, apply one-half these amounts on a more frequent schedule
Tomatoes are fertilized differently

- They produce an excess of foliage and a shortage of ripe tomatoes if they receive too much extra nitrogen.
Scatter the fertilizer near the plants before a sprinkler irrigation

- You don’t need to dig it in
- With flood irrigation, place the fertilizer along the furrow near the "shoulder" before turning in the water
Container and small grow boxes work well for vegetable growing.
Many vegetables grow well in containers Sagers Garden
Artificial soils have no nutrients
Be certain to supply enough nutrients to promote good growth
Container and small grow boxes for vegetable growing

- Slow release fertilizers are useful to help provide continuous nutrition
Container and small grow boxes for vegetable growing

• Plants grown in these are susceptible to nutrient deficiencies
What About Manure?
Manures, when available, may help raise soil nutrient levels

• Their use is a good way to recycle “waste” products
• They add to the organic matter content of the soil which improves tilth and the ability to hold water and nutrients
• They also could add weed problems
It is virtually impossible to know the nutrient content of manures

- Their source, amount and type of straw or other bedding materials, and leaching by rains will all vary
- Poultry manure that has not been exposed to rain contains the most nitrogen
Poultry Manure

• Manure of this type should be added at the rate of 100–150 lbs. per 1,000 sq. ft.

• Weathered steer or horse manure with lots of straw can require up to 1,500 pounds per 1,000 sq. ft. to supply enough nutrients.
Some horse bedding

• Can have so much straw or shavings that the manure doesn’t furnish enough nitrogen to decompose it
• Ammonium sulfate, 10 lbs. per 1,000 square feet per inch of added material will supply that nitrogen
Some manure is low in phosphorous

- Add 4 lbs. of triple super phosphate 0-45-0 or equivalent in mixed fertilizer when manure is applied
Many gardeners use supplemental fertilizers to get enough nutrients

- Synthetic fertilizers can insure gardening success if manures are of inadequate supply or quality
Organic gardeners follow other standards

- These are available from the Utah Department of Agriculture and Food
- You cannot use synthetic fertilizers within the last three years and still certify your crops as organic
Plant fertilization needs the gardener to be involved

- There is no substitute for an experienced gardener learning to read the garden plants
- Guidelines help but plants grow differently depending on many other conditions
- Adjust nutrient need to the plants
Sixteen Essential Elements
Nutrients Derived from Air & Water

Carbon (C)

Hydrogen (H)

Oxygen (O)
Primary Nutrients

Nitrogen (N)

Phosphorus (P)

Potassium (K)
Nitrogen Uptake

$\text{NO}_3^-$  $\text{NH}_4^+$
Soil Nitrogen

- Mostly Unavailable - in O.M.
- About 2% Available per year
- In Western Soils 20 Lbs./A./Yr.
Air - 78% N
Nitrogen Fixation

- Legumes
- Free Living Organisms
- Lightning
- Fertilizer Industry
NITROGEN Deficiency Symptoms

- Slow Growth Stunted Plants
- Yellow-Green Color (Chlorosis)
- Firing of Leaf tips & Margins Beginning with more Mature Leaves
Phosphorus Uptake

$\text{H}_2\text{PO}_4^-$

$\text{HPO}_4^{2-}$

$\text{PO}_4^{3-}$
### Soil pH Effect on Phosphorus Availability

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<th>Slightly Acid</th>
<th>Very Slightly Acid</th>
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**MOLYBDENUM**
Phosphorus Fixation

- Alkaline Soils: Calcium Phosphates
- Acid Soils: Iron & Aluminum Phosphates
PHOSPHORUS AVAILABILITY

- Amount in Soil
- Soil Moisture
- Soil Temperature
- Soil pH
- Plant Root Growth

"Available Soil Phosphorus May Be Only 1% or Less of the Total Amount Present."
Nitrogen Increases Phosphorus Uptake

- Increased Root Growth
- Physiological Changes in Root Growth
- Increased Transfer of P to Xylem
- Lowering of Soil pH
Phosphorus Promotes

Early Growth

Root Formation

Maturity

Seed Production
PHOSPHORUS
Deficiency Symptoms

- Slow Growth - Stunted Plants
- Purplish Coloration on Foliage
- Dark Green Coloration
- Delayed Maturity
- Poor Grain, Fruit or Seed Development
Potassium Promotes

- Translocation of Sugars
- Starch Formation
- Stomatal Function
- Root Growth
- Disease Resistance
- Crop Quality
Potassium in Soils

- Unavailable: 90 - 98%
- Slowly Available: 1 - 10%
- Readily Available: 1 - 2%
POTASSIUM Deficiency Symptoms

- Tip and Marginal "Burn" - Mature Leaves First
- Weak Stalks - Plants "Lodge" Easily
- Small Fruit or Shriveled Seeds
- Slow Growth
<table>
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<tr>
<th>Micronutrients</th>
<th>Zinc</th>
<th>(Zn)</th>
<th>Boron</th>
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<td>Copper</td>
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</table>
ZINC

- A Constituent of Enzyme Systems
- IAA Synthesis (Growth Regulator)

Absorbed as Zinc Ion
ZINC
Deficiency Symptoms

- Decrease in Stem Length
- Rosetting of Terminal Leaves
- Reduced Fruit Bud Formation
- Mottled Leaves (Interveinal Chlorosis)
- Dieback of Twigs After First Year
- Striping or Banding on Corn Leaves
IRON

- Chlorophyll Formation (Photosynthesis)
- Respiration
- Symbiotic N Fixation

Fe^{++} Fe^{+++}

Absorbed as Ferrous or Ferric Ions
IRON Deficiency Symptoms

- Interveinal Chlorosis of Young Leaves
- Twig Dieback
- In Severe Cases, Death of Entire Limbs or Plants
Iron Chlorosis Is the Most Serious Micronutrient Deficiency In Utah

- Soils usually have sufficient iron
- Iron is unavailable because of high pH and high calcium in the soil
- Iron chlorosis is aggravated by overwatering
Diagnosing Nutrient Needs

- Soil Testing
- Tissue Analysis
- Visual Symptoms
  - Deficiencies
  - Toxicities
The End

Happy Growing To Everyone