



Extension Gardener Short Course: **Sustainable & Organic Vegetable Gardening**

Charlotte Glen,
Horticulture Agent
NC Cooperative Extension –
Chatham County Center



Last Week

- Finding the right site
- Preparing the soil
- Soil testing



Next Week

Managing pests

- Insects
- Diseases
- Weeds
- Critters



Class 2:

Planting for Year Round Harvest

1. When to plant
2. What to plant
3. Keeping crops growing
4. Tips for specific crops

Course webpage:

<http://go.ncsu.edu/veg-short-course>



When to Plant

- Based upon temperature adaptation of crops
- **Not the same as the produce aisle!**
- Not the same as other areas of the country!



When to Plant

Cool Season Crops:

- Plant **July-Sept** for fall crop
- **Feb-April** for spring crop

Warm Season Crops:

- Plant after average last spring frost date, **~April 15**
- Second planting **July-Aug** for fall harvest



Central North Carolina Planting Calendar for Annual Vegetables, Fruits, and Herbs

Central North Carolina is a wonderful place to garden. Almost any type of vegetable or fruit can be grown successfully provided you choose appropriate varieties and plant at the right time. Climate, the season, and potential pests all affect the selection of what and when to plant.

Adapted to Climate: Freezing temperatures, high temperatures, humidity, and solar intensity, all common in central North Carolina, can put stress on plants. To successfully grow plants in this environment, select varieties that are tolerant of temperature extremes, plant at the appropriate time, and choose varieties that mature quickly.

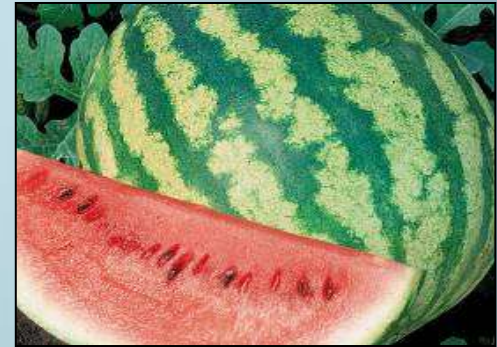
between seasons (short days and cold temperatures in winter to long days and high temperatures in summer). Since few annual plants are suited to thrive in both circumstances, it is important to choose plants that mature quickly to ensure a complete life cycle within one season.

Behind Tab 4 in your notebook

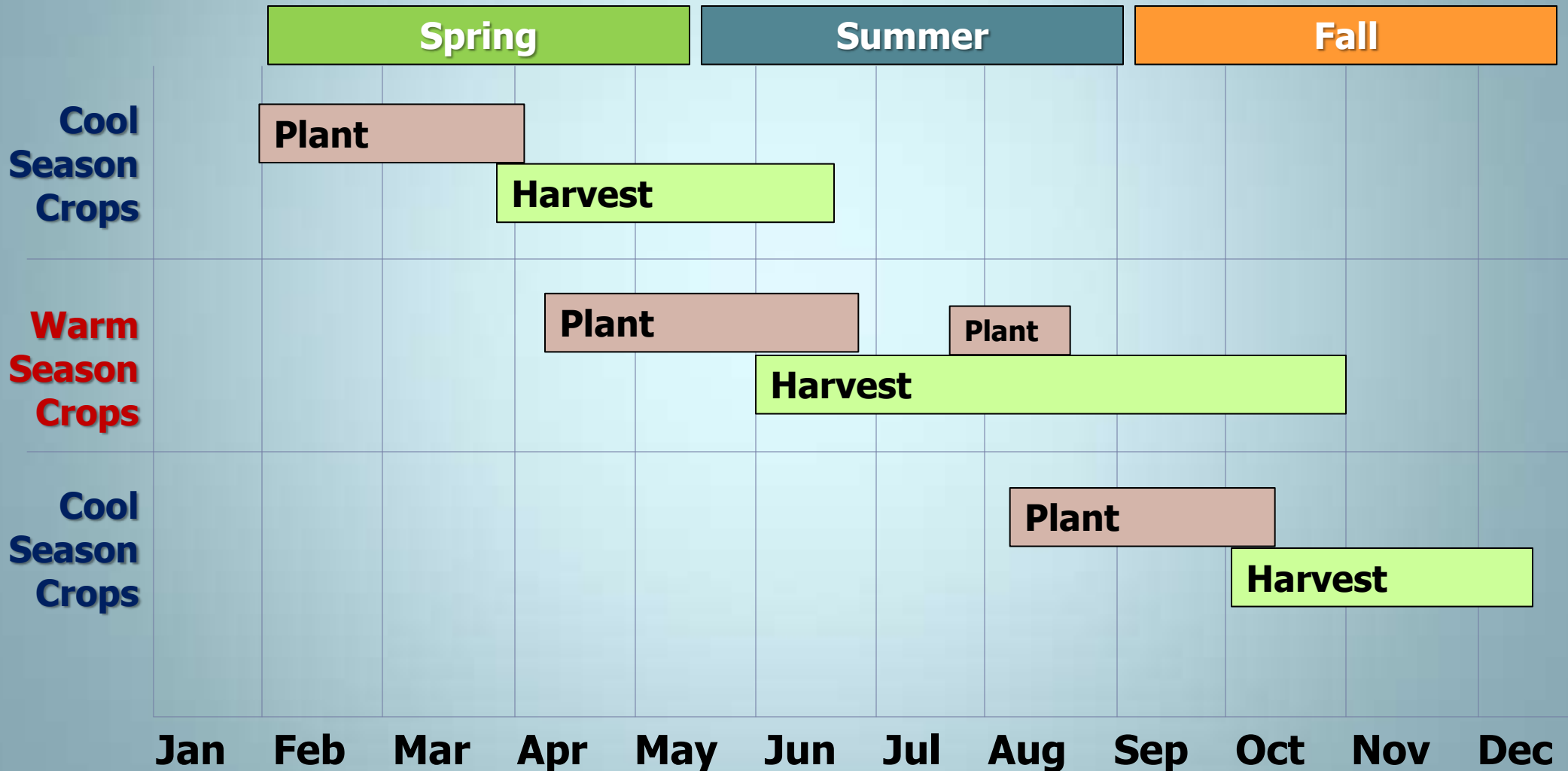
COOL SEASON



WARM SEASON



Planting Seasons



Extend Winter Harvest

- **Row cover fabrics** – spun polyester
 - 2-4 degrees protection in spring
 - 8-10 degrees in fall
- Stake down edges well
- If use plastic, vent during sunny days



Extend Growing Season

- **Cold Frames** – unheated
- Keep crops producing later in the season OR start earlier in spring
 - 2-4 weeks
- **Not enough protection for warm season crops in winter**





Face south for
maximum sun
exposure



High Tunnel

- Unheated greenhouse
- Grow cool season crops all winter
- Sides roll up for ventilation



Summer Season Extension

- **Shade Cloth** – blocks 30% of light
- Keep lettuce, spinach, Swiss chard **producing longer into summer**
- **Start seeds** in summer, reduce stress on transplants
- **Shield summer crops** during extended periods of 90°+ days



What to Plant

Transplants

- Small/young plants
- **Easy** – higher rate of success!
- Good when only need a few plants
- For crops planted as individual plants (tomatoes, peppers, cabbage)
- Can grow your own transplants – sow seed 4-6 weeks before you plan to set out



What to Plant

Seed

- Greater variety
- **Sow directly into garden**
 - Some must be seeded – root crops
 - Salad green patches
- **Sow in containers**
 - To grow transplants
 - To grow in containers
- **Most vegetable seed store for 2-3 years** – plastic bag in refrigerator



Sowing Direct

- **Well prepared soil**
- **Keep moist!**

Options:

- Sow in place where will grow, thin after seedlings emerge
- Sow and then transplant to permanent location

Sow carefully or thin to correct spacing



How Vegetables are Typically Planted

Warm Season

Seed Sown Direct

- Beans and Field Peas
- Peanuts
- Sweet Corn
- Radish
- Rutabaga
- Turnips, Mustard
- Carrots
- Beets
- Garden Peas
- Potatoes (seed potatoes)

Cool Season

As Transplants

- Tomatoes
- Peppers
- Eggplants
- Sweet Potatoes
- Okra
- Basil
- Broccoli, Cauliflower
- Cabbage, Collards
- Kale
- Garlic – cloves

Both ways: lettuce , spinach, parsley, dill, cilantro, onions (seed or sets);
cucumber, squash , zucchini, melons

What to Plant

Open Pollinated

- **'Heirloom' varieties** – can save own seed and varieties will come true to type

Hybrid

- Result of a cross between 2 or more parents – saved seed do not come true
- Usually more uniform, more vigorous, more disease resistant

Hybrids are not GMOs!



Plant Recommended Varieties

- New varieties are always coming out!
- For tried and true **check Extension publications:**

Extension Search:

<https://search.extension.org>

- Searches all Extension and University Publications
 - Look for fact sheets from southern states (NC, SC, VA, GA)



How to Plant

- Sow or plant new crop every 2-3 weeks to extend harvest time
 - **Necessary for 1-time harvest crops** (eg. Cabbage, corn, root crops)
 - **Not needed for crops with long harvest season** (tomatoes, peppers, melons, kale)



Keeping Crops Growing

- **Water!** Goal = keep top 6-8" of soil moist
 - Raised beds, sandy soils require more frequent watering
- **Drip systems** best
- **Manage pests** – next week
- **Supply nutrients**
 - Some incorporated before planting



Supply Nutrients

- **Based on soil test results**
 - Test every 3-4 years
- **Can test any time of year**
 - Wait 8 weeks after applying lime or fertilizer
 - Can test after incorporating compost, if completely decomposed (no longer generating heat)
- Reports from most recent 3 years posted:
<http://www.ncagr.gov/agronomi/pals>



Nutrient Sources

Synthetic

- Manmade
- More predictable, higher analysis
- More likely to leach, burn



Natural

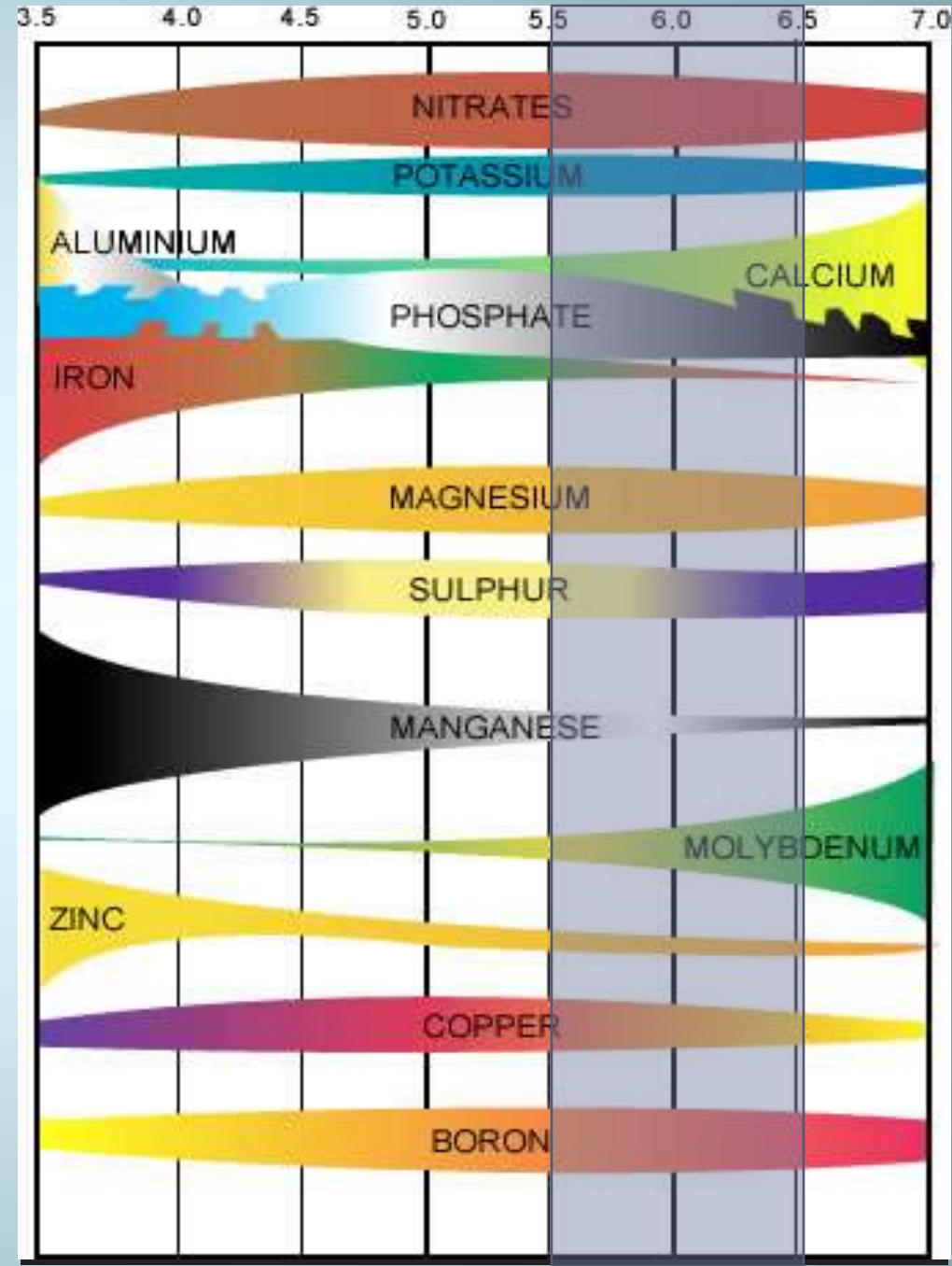
- Often low analysis, slow to release
- Condition the soil – feed microbes
- More expensive
- Do not release well in cold weather – rely on microbes to break down



5.5 – 6.5 ideal for most plants

First, Check pH

- Soil pH effects nutrient availability
- Under extremely acidic conditions (>5.0) root growth limited
- Over 7.0, some micronutrients less available
- Most native Piedmont soils are acidic, below 5.5





Predictive Home & Garden

Soil Report

Mehlich-3 Extraction

Client: Charlotte Glen
P.O. Box 279
Pittsboro, NC 27312

Advisor:

Sampled County : Wayne

Sampled:

Received: 04/21/2015

Completed: 04/30/2015

Farm:

[Link to Helpful Information](#)

Agronomist's Comments:

This report provides Test Results and Recommendations for each sample submitted for testing. Look for Lime Recommendations and N-P-K Fertilizer Recommendations. If lime is needed, application at the indicated rate will raise soil pH to the optimal level for the plant you specified. Common target pH values are as follows: 5.0 for azalea, camellia, rhododendron and mt. laurel; 5.5 for centipedegrass; 6.0 for other lawn grasses, shrubbery, and flowering plants; and 6.5 for vegetable gardens. N-P-K Recommendations are based on the nitrogen (N) needs of the plants being grown and the soil test results for phosphorus (P-I) and potassium (K-I); a 50 to 70 index for either is optimum. If the exact fertilizer cannot be found, find the closest match and adjust the rate accordingly. Refer to "Understanding the Soil Report" (last page of this report) for additional explanation and links to helpful information.

Sample ID: RED

Crop 1- Vegetable garden

Crop 2-

Lime History:

Test Results:

pH = 5.0



Charlotte Glen

Lime Recommendations

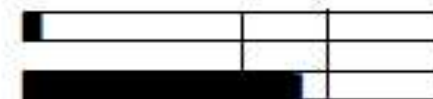
75.0 lb per 1,000 sq ft

N-P-K Fertilizer Recommendations *

20 lbs per 1,000 sq ft 5-10-5

Phosphorus Index (P-I) = 1

Potassium Index (K-I) = 65



Below Optimum Optimum Above Optimum

Additional Test Results:	HM%	W/V	CEC	Mn-I	Zn-I	Cu-I	S-I
	0.04	0.79	5.7	62	18	26	222
		g/cm ³	meq/100 cm ³				

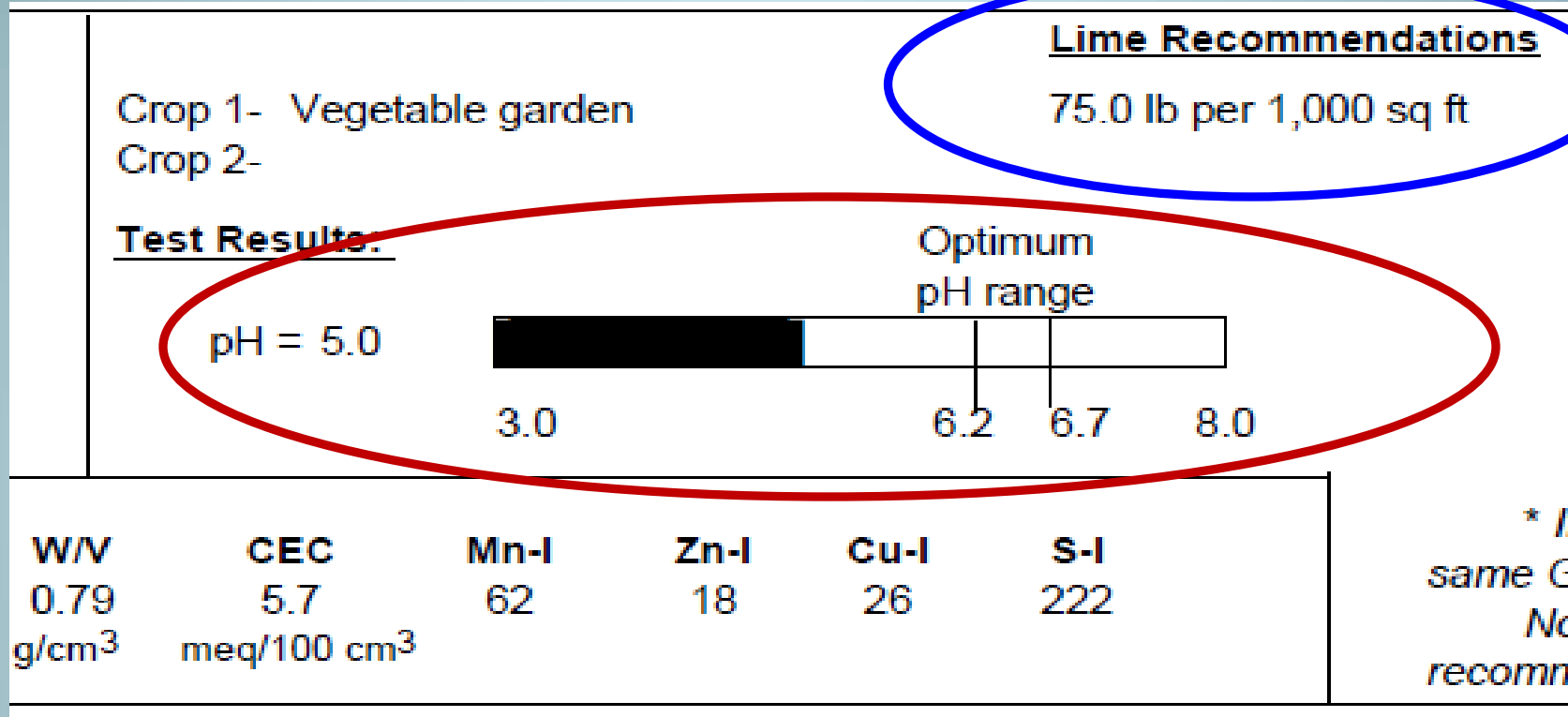
* If you cannot find the fertilizer recommended here, choose one from the same Group (A, B, C or D) listed on the last page of this report.

Note: This soil test does not measure nitrogen (N) levels. N fertilizer recommendations are based only on needs of the designated crop.

Soil test report provides a baseline for:

- Soil pH
- Phosphorous levels
- Potassium levels

pH & Lime Recommendation



- **pH level** – Actual number + shows where your pH is in comparison to target range (based on soil type and what you intend to grow)
- **Lime recommendation** – for dolomitic or agricultural/garden lime, pounds per 1000 square feet

Should You Alter pH?

- **If low, YES! Lime raises pH** – only add lime if recommended; add agricultural or dolomitic lime
 - **Till lime into the soil before planting** – takes 6 months to fully react
- **IF high, maybe. Sulfur lowers pH** – consider adding if pH over 7.0 and plants show micronutrient deficiency symptoms



Micronutrient Deficiency



Zinc



Magnesium



Iron

Epsom Salts = Magnesium sulfate, lowers pH and provides Mg and S, two nutrients that are often deficient at higher pH – apply 2-3 times a season

Lime Recommendations

75.0 lb per 1,000 sq ft

$$8 \times 4 = 32 \text{ sq. ft.}$$

$$.032 \times 75 = 2.4 \text{ lbs}$$

4 ft

8 feet

To determine area (sq. ft.) of a rectangle,
multiply length x width

If your area is less than 1000 sq. ft., divide:

- If only 32 sq. ft., divide $32/1000 = .032$
- Multiply $.032 \times 75$ (recommended rate) to determine how much lime needed for bed

Plant Nutrients:

Macronutrients

<u>Air & Water</u>	<u>Primary</u>	<u>Secondary</u>
Carbon (C) Hydrogen (H) Oxygen (O)	Nitrogen (N) Phosphorus (P) Potassium (K) Most Fertilizers Provide	Calcium (Ca) Magnesium (Mg) Sulfur (S) Dolomitic lime provides Ca and Mg

Plants need these in large quantities

Plant Nutrients:

Micronutrients

Iron (Fe)

Manganese (Mn)

Copper (Cu)

Zinc (Zn)

Boron (B)

Molybdenum (Mo)

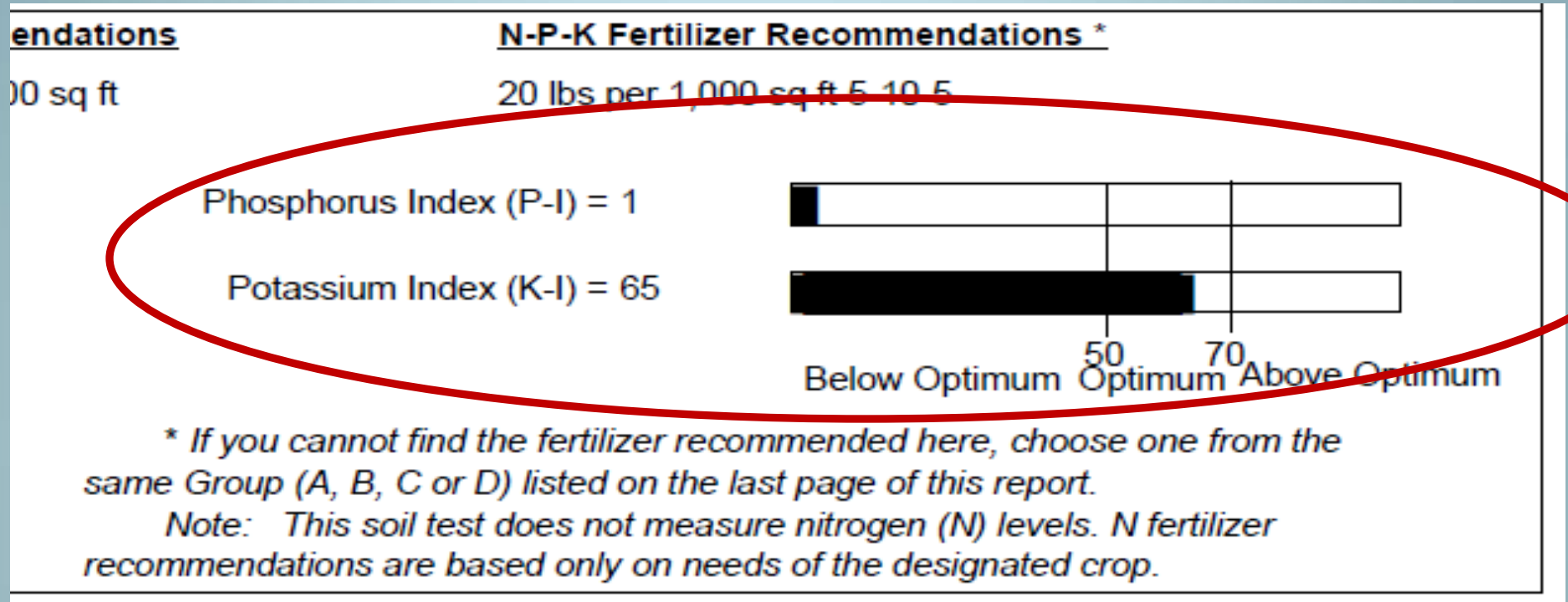
Chlorine (Cl)

Micronutrients are just as essential as Macronutrients, But are needed in smaller amounts.

If pH is not too low/too high, most soils provide these – No need to add unless specific note in soil test report

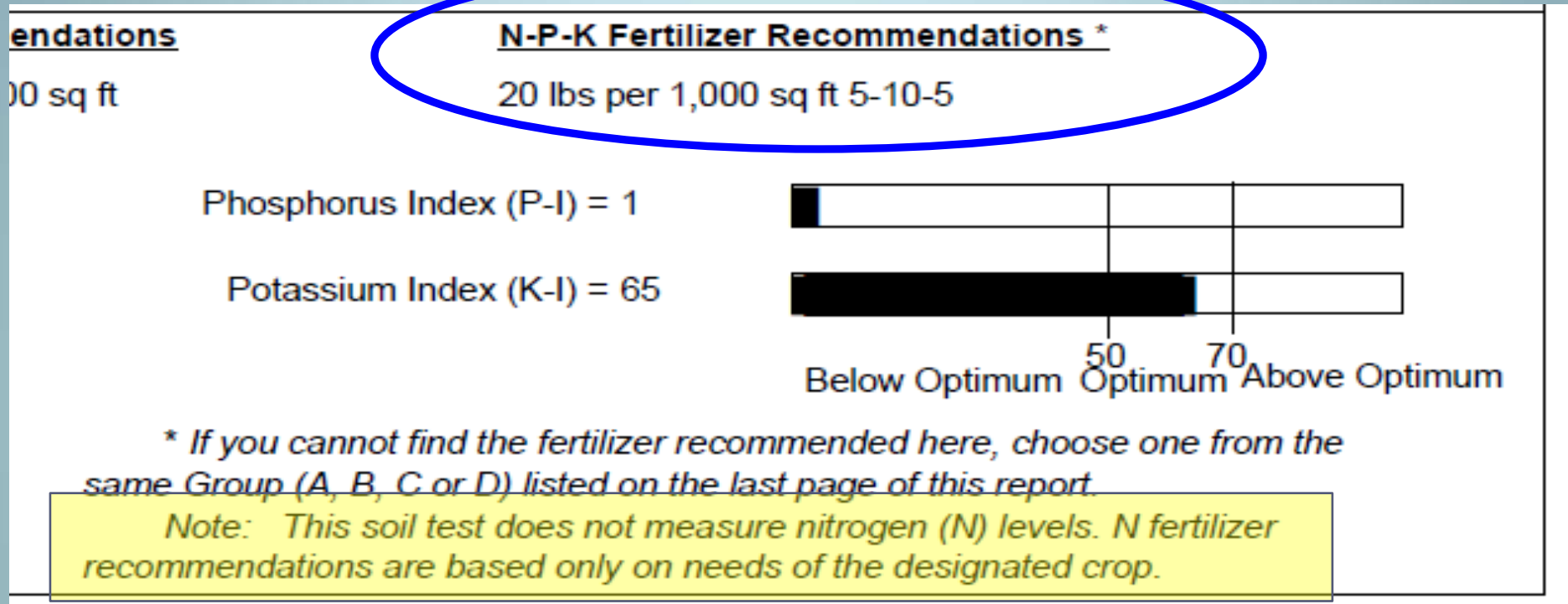
See [Extension Gardener Handbook: Soils Chapter](#) to learn more!

Nutrient Levels



- **Phosphorous (P-I) and Potassium Index (K-I)** – between 50 and 70 is ideal, less than 50 fertilizer recommended; over 50, no economic benefit of adding more
- **P-I** often very low on unimproved soils; may be very high in farmed/cultivated soils

Fertilizer Recommendation

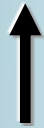


- **No Nitrogen (N) index** – N levels too volatile to measure
- **Fertilizer Recommendation** – in pounds per 1000 square feet – P & K based on soil levels, N based upon crop to be grown. **P must be incorporated!**

What the numbers mean:

Number represent % of:

N



Nitrogen
New growth

P



Phosphorus
Roots, Flowers
and Fruits

K



Potassium/Potash
Flavor and
Hardiness

For a 100 pound bag of fertilizer:

5 – 3 – 3

= 5 lbs N + 3 lbs P + 3 lbs K + 89 lbs bulk material

N-P-K Fertilizer Recommendations *

20 lbs per 1,000 sq ft 5-10-5

Phosphorus Index (P-I) = 1

Potassium Index (K-I) = 65

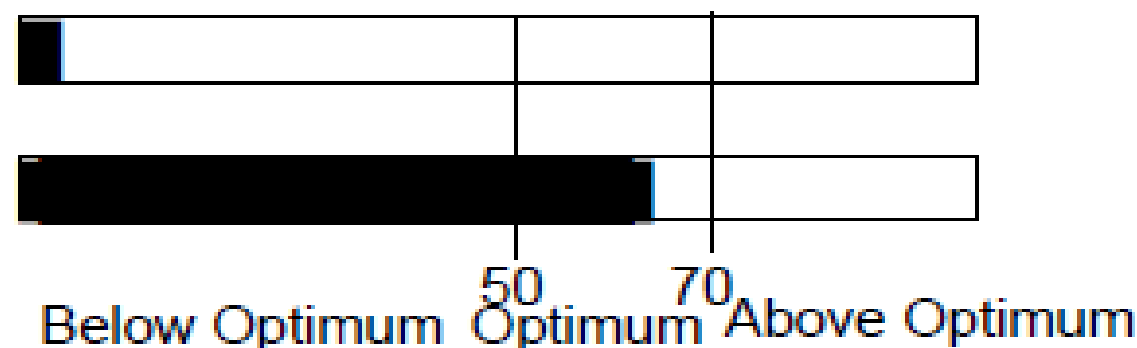


Table 1. Groups of equivalent fertilizers that supply 1 lb of N per 1,000 sq ft *

Group A: low P-I + low K-I	Group B: low P-I + high K-I	Group C: high P-I + low K-I	Group D: N only
5-10-10 @ 20 lb	5-10-5 @ 20 lb	8-0-24 @ 12 lb	15-0-0 @ 7 lb
3-9-9 @ 30 lb	18-46-0 @ 6 lb	15-0-14 @ 7 lb	21-0-0 @ 5 lb
10-10-10 @ 10 lb	18-24-10 @ 6 lb	6-6-18 @ 18 lb	16-0-0 @ 6 lb
11-15-11 @ 10 lb	9-13-7 @ 11 lb	5-5-15 @ 20 lb	28-0-4 @ 4 lb
8-10-8 @ 12 lb	9-17-8 @ 11 lb	10-0-14 @ 10 lb	12-6-6 @ 8 lb

* Since these rates supply 1 lb N per 1,000 sq ft, use half the rate if centipede is the grass type.

Can't Find The Recommended Analysis?

1. Find something with similar ratio, for example, 5-10-5 is a 1:2:1 fertilizer and adjust rate accordingly
2. Use a complete fertilizer but **always base application rate on Nitrogen**
– eg., if you have 5-3-3 (Plant-tone), apply 20 lbs/ 1000 sq. ft.



Nitrogen

- Recommendation always for **1 lb of actual nitrogen per 1000 sq. ft.**
- To determine rate of actual nitrogen, **multiply lbs fertilizer recommended by %N**
 - 20 lbs of 5-3-3 = 5% Nitrogen
 - 20 lb fertilizer x .05 Nitrogen = 1 lb actual N per 20 lbs fert



Feather Meal
12-0-0

Nitrogen

- To determine how much of any fertilizer is needed to apply 1 lb of actual N, divide %N (1st number of analysis) into 100
 - For 5-3-3, $100/5 = 20$ lbs
 - For 12-0-0, $100/12 = 8.3$ lbs
- **Apply ½ at planting time, ½ 6-8 weeks later**
- **Monitor plants for signs of deficiency**
 - Yellowing of older, lower leaves



N deficiency

Nitrogen

- **As soil organic matter levels build**, less additional N is needed
 - N in organic matter not rapidly available
- **Available N leaches** – often see temporary deficiency after rainy spell
- **Liquid fertilizers** helpful when deficiency noticed or when setting out transplants
 - Compost or manure tea
 - Fish emulsion
 - Kelp emulsion



5-1-1

Increasing Soil Organic Matter

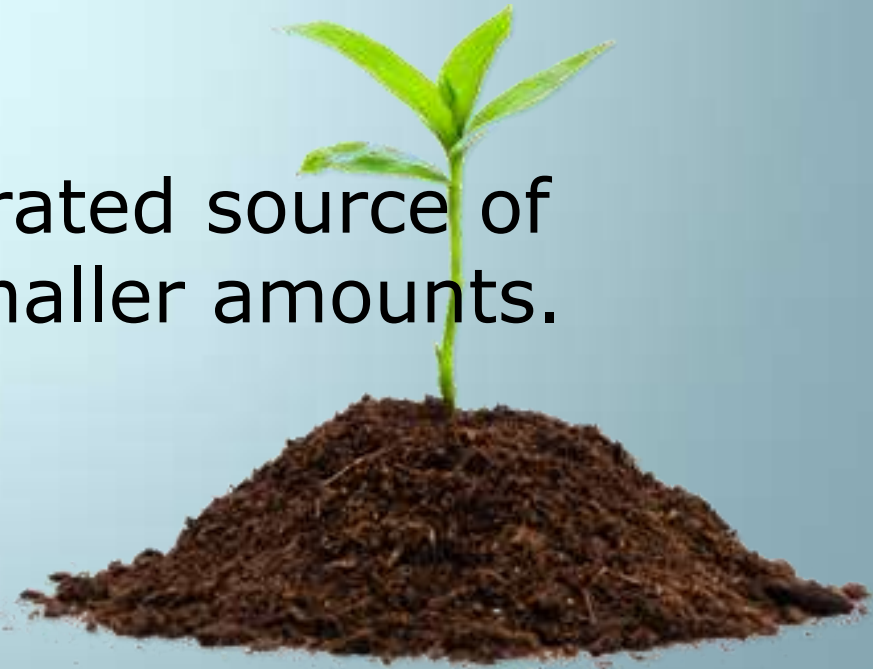
- **Add compost!**
 - Incorporate with initial soil preparation
 - Incorporate when need to alleviate compaction
 - Topdress 1"-2" if soil not compacted
- **Grow cover crops**
- **Minimize tilling**



**Buckwheat = fast cover
crop for summer**

Compost vs. Fertilizer

- **Compost** = Improves soil structure, improves nutrient holding capacity of soil, supports microbes, adds some nutrients but often not enough + N not immediately available
 - Typical analysis: 2-1-1
 - Extremely variable!
- **Fertilizers** = more concentrated source of nutrients. Added in much smaller amounts. Typical analysis:
 - Organic: 5-3-3
 - Synthetic: 14-14-14



If need N only

- Blood meal is the most common natural N source
- Dried Blood is 12% nitrogen, 12-0-0

To determine how much is
needed per 1000 sq. ft. to
supply 1 lb of nitrogen,
divide 12 into 100:

$$100/12 = 8.3 \text{ lbs per } 1000 \text{ sq. ft.}$$

For 32 sq. ft.:

$$8.3 \times .032 = .27 \text{ lbs}$$



If need additional Phosphorous

- **Bone Meal**

- Natural
- 0-10-0
- 10% P

- **Triple Super Phosphate**

- Synthetic
- 0-45-0
- 45% P

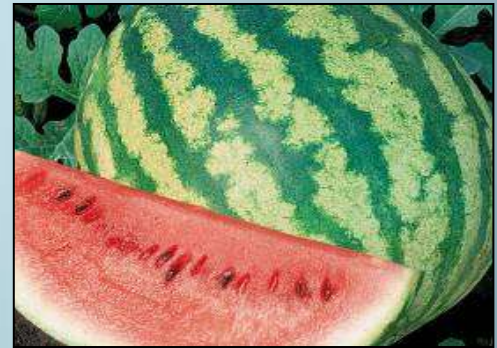


Additional Information:

Additional Test Results:	HM%	W/V	CEC	Mn-I	Zn-I	Cu-I	S-I
	0.04	0.79	5.7	62	18	26	222
		g/cm ³	meq/100 cm ³				

- If there is a problem, will be noted in agronomist's comments just under report header
- See [Understanding the Soil Test Report](#) for details

Tips for Growing Cool and Warm Season Crops



Cool Season Vegetables

Tolerate frost:

Hardy: tolerate heavy frost (below 28 degrees), can produce into the winter

- Cabbage, kale, collards, carrots
- Spinach, turnips, mustard greens, broccoli

Half-hardy: tolerate light frost (28 - 30 degrees), usually productive through December – extend season with cold frames or row covers

- Beets, cauliflower, chard, lettuce, Chinese cabbage



Cool Season Crops: Heat Effects

- **Flavor not as good**
when mature in warm weather
- **Bolting** – late plantings of cool season crops are more prone to bolting
- If have room, allow CS crops to bloom – attract pollinators and beneficials
- **Blossoms edible!**



Leafy Greens

- **Lettuce, mustard and turnip greens, chard, spinach**
- Most are quick growing, ready to harvest in 30 to 40 days
- **Can be sown direct in wide or single rows**
- Lettuce, spinach and chard often available as transplants
- **Multiple harvest**, except head lettuce



Lettuce grown in 18" wide rows

Leaf Lettuce

- Do not form dense heads
- **Easiest lettuce**– transplants and seed available
- Many color variations, leaf shapes
- Can plant as single plants or in patches
- Make **successive sowings** every 2 weeks through April – later in part shade
- Iceberg lettuce will not grow here!



Crucifers/Cole Crops

- **Broccoli, Cauliflower, Cabbage, Collards, Kale, Brussel Sprouts**
- Slower growing, productive over longer time – many are **winter hardy**
- Can be grown from seed sown in early August (fall crop) or February (spring crop)
- Or set out as transplants in September or March
- Large plants, space individual plants 18" to 2' apart



Give cole crops
plenty of space!

Root Crops

- Carrots, beets, kohlrabi, rutabaga, radish, turnips
- **Do not transplant** – almost always sown in place in the garden
 - Fall crops sown Aug/Sept
 - Spring crops sown Feb/March
- Need loose, well drained soil for good root development
- Harvest once, must succession sow



Root crops can be grown in containers – carrots need deep pots!

Onions and Their Relatives

- Onions, Garlic, Leeks
- Do best in our area when fall planted!
- Harvested in spring
- **Heavy feeders** – like lots of organic matter and consistent moisture and nutrients
- Need good drainage

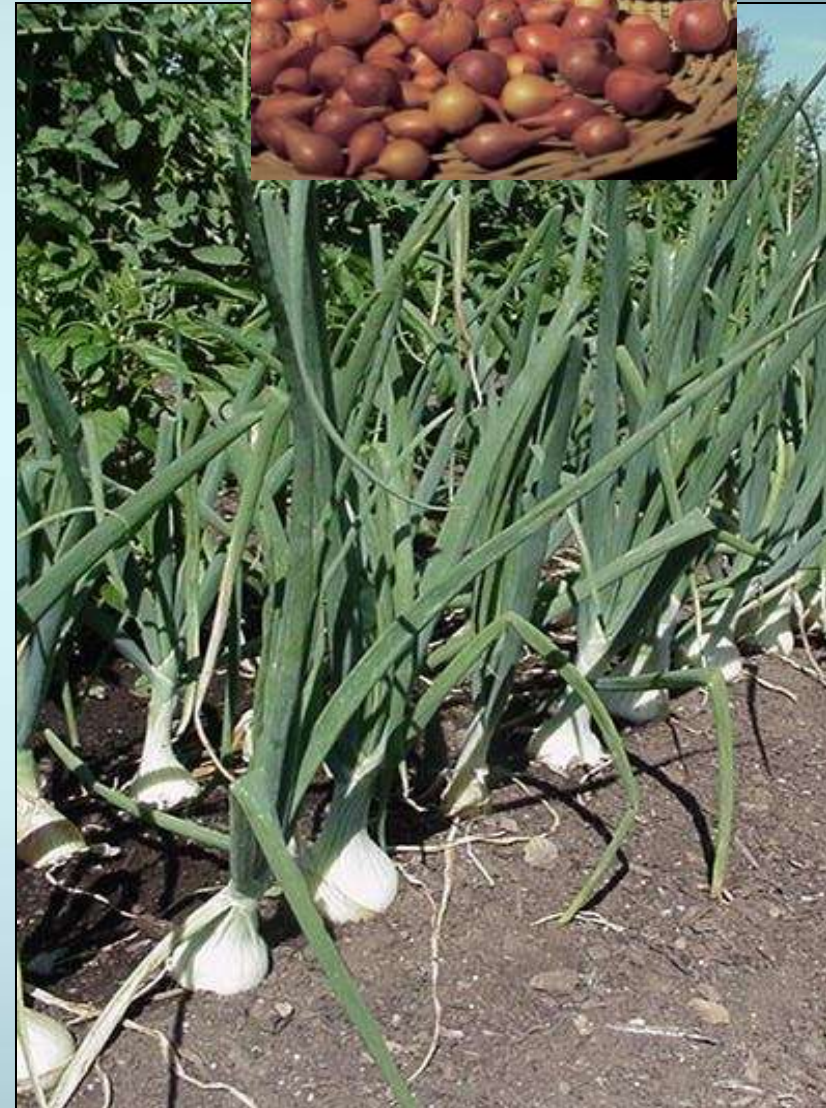


Green onions/scallions are very easy to grow spring-fall. Ready to harvest in 50-60 days.

Onions

- Sow direct in October to harvest in April-May
- Short Day varieties: 'Grano', 'Granex', 'Texas Super Sweet'
- Seed usually more successful and cost less than sets
- Thin in Jan to 4" apart for larger bulbs
- Need lots of Nitrogen in spring, but **no sulfur**

Onion Sets



Garlic

- Plant in Sept/Oct to harvest in late spring
- **Grown from cloves**
- **Soft Neck** varieties grow best in the south – have stronger flavor
- **Elephant garlic** also does well – very large with mild flavor



Spring Only Crops

Garden, Sugar Snap and Snow Peas

- Harvest in 60 days
- Sow It. Jan – early March
- Powdery Mildew a problem on later crops
- Sugar snaps and snow peas more heat tolerant
- Vines - need support





Spring Only Crops

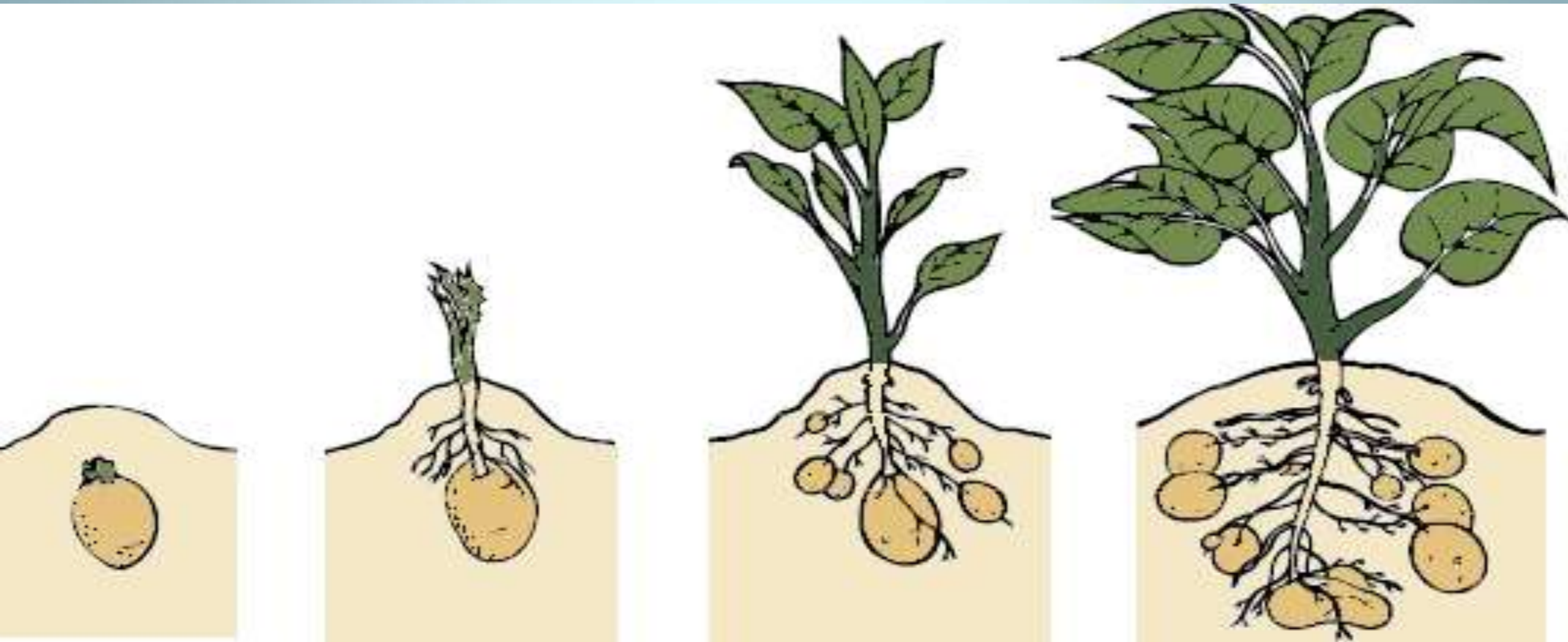
Potatoes

- 90 – 120 days
- Start with certified seed potatoes, Feb. – mid March
- 'Yukon Gold', 'Kennebec', 'Pontiac'
- Mound soil around plants through the growing season for more production
- Baking potatoes will not grow here!



Growing Potatoes

- **Mound soil** – all potatoes develop between 'seed' and soil level

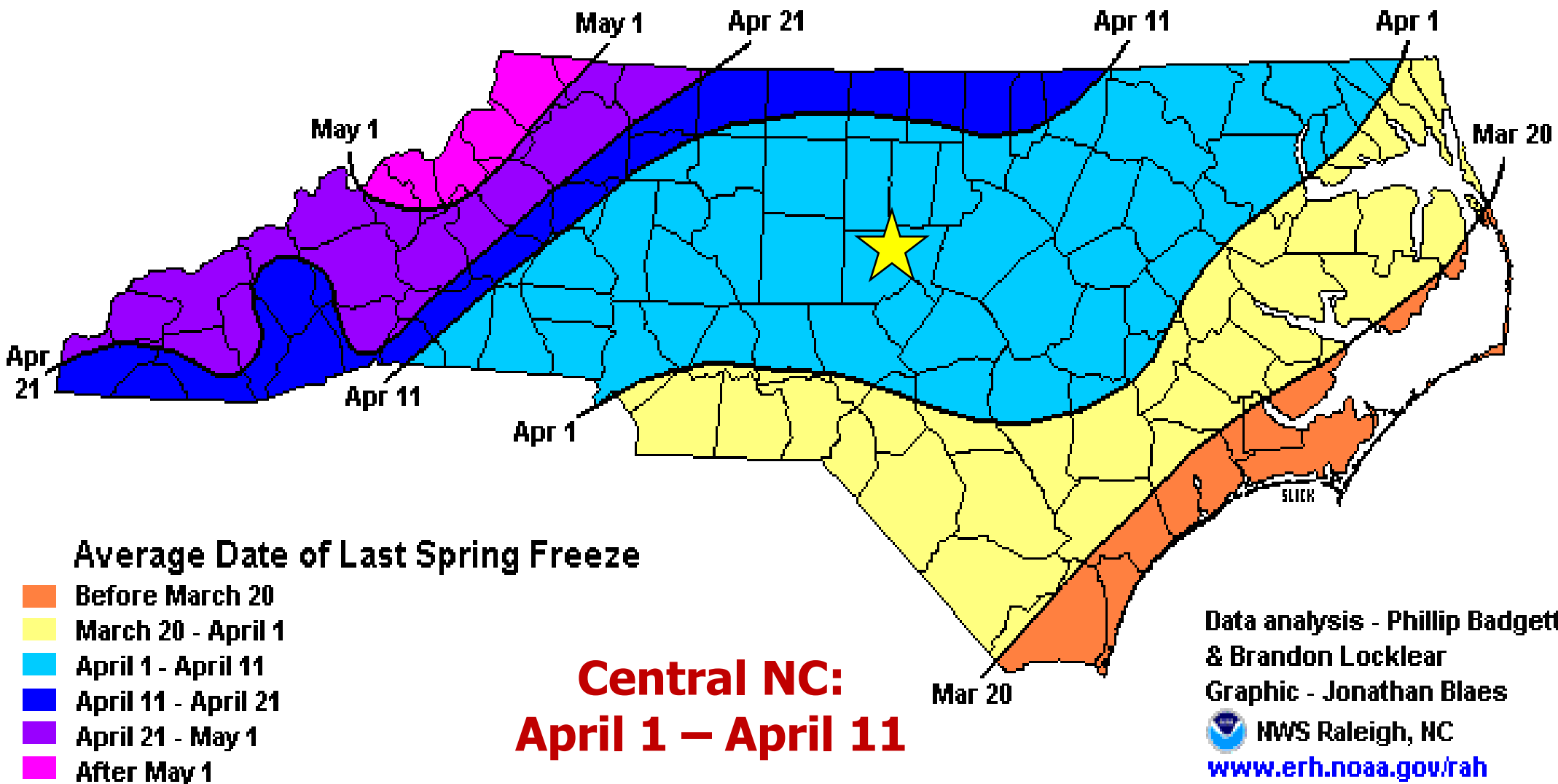


Warm Season Crops

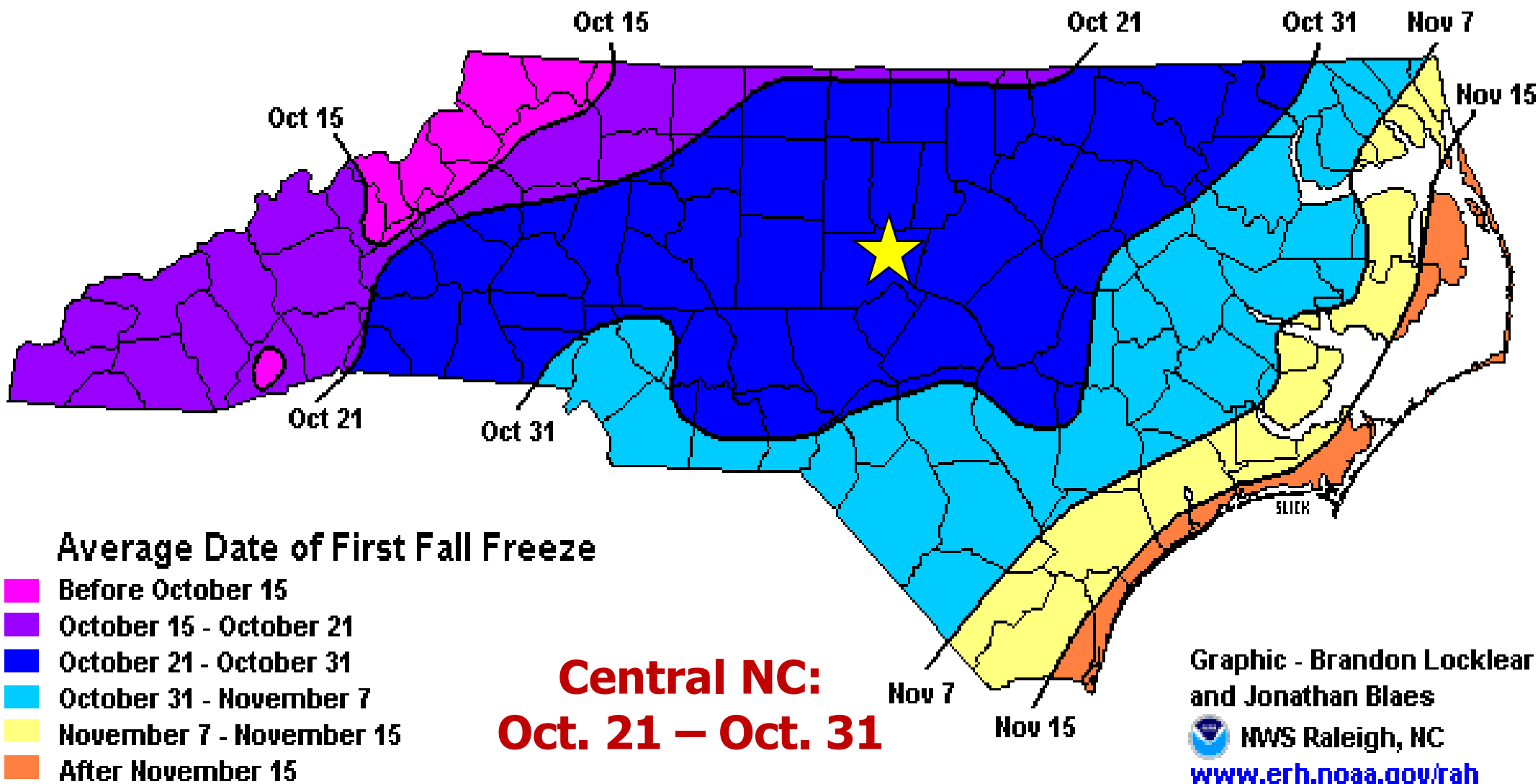
- Need warm (70's – 80's) temps to grow well, and warm soil temperatures (at least 60)
- **Soil warms slower than air!**
- Not frost tolerant, but some will tolerate cooler temps
- **Hot temperatures will reduce production** (mid 90's and above)
- Drought stress will reduce production!



**ss protected by cold frame/high tunnel
plant after
Average Date Last Spring Freeze**



For fall crop, plant 12 weeks before Average Date of First Fall Freeze



Tomatoes!

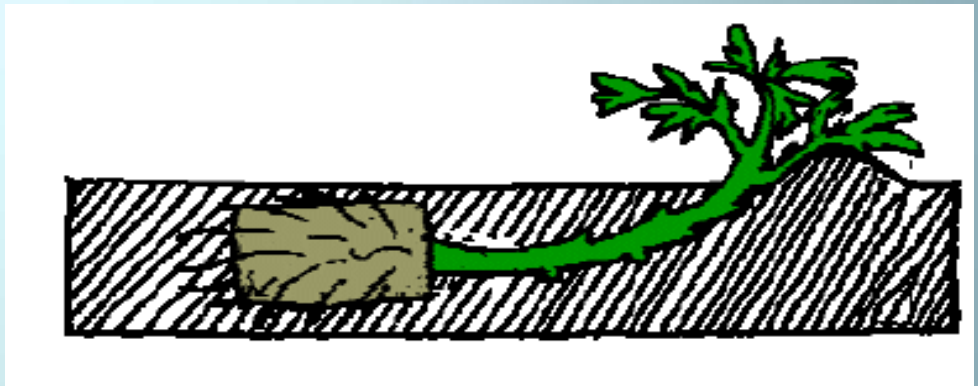
- **Plant as early as possible** – protect from frost!
- **Space plants 3' apart**
- **Cage** tomatoes at planting time
- Avoid planting tomatoes in **same location** year after year
- Plant **multiple varieties**
- Plant in a couple of **different locations**

Cages should be at least 4' tall – taller indeterminate varieties



Plant Deep!

- Tomatoes will produce roots along their stems – **deep planted tomatoes** have larger root systems



Tall, leggy tomatoes can be planted laying sideways, with the top 3-4 sets of leaves above ground

Types of Tomatoes

- **Determinate**
 - Mature crop all at once
 - Good for canning
 - Plants stay smaller
- **Indeterminate**
 - Set successive crops over long season
 - Keep growing = tall plants
 - **Semi-determinate** keep producing over long season but plants stay relatively compact



Indeterminate varieties need tall support trellises

Heirloom Tomatoes

- Local selections that have been preserved over the years
- **Flavor but little disease resistance**
- Some better adapted to south than others:
 - **'German Johnson', 'Homestead', 'Cherokee Purple', 'Marglobe'**
- Most are **indeterminate**
- **Can save seed** – come "true to type"



Disease Resistance

- **Hybrids** developed for disease resistance
- Most important disease resistance to look for:
 - **V** - Verticillium
 - **F** - Fusarium
 - **N** - Nematodes
- **No tomato is resistant to all** (or even most) tomato diseases!
- **No resistance to most soil borne wilt diseases**



Reliable Hybrid Varieties

- **Cherry Tomatoes – easiest!**

- **Sweet 100, Sweet Million,** and **Juliet** are favorites

- **Celebrity**

- Determinate, F & N resistant
- **Bush Celebrity** is good for containers

- **Better Boy, Early Girl**

- Indeterminate, Better Boy - F & N resistant, Early Girl – F resistant

- **Big Beef**

- Indeterminate, extra large fruit, F & N resistant
- **Big Boy** is similar, NOT F,N resistant



'Juliet' Tomato

Tomato Relatives:

Eggplant & Peppers

- Generally easy
- **Susceptible to wilt diseases**
- Hot peppers have good drought resistance
- Bells very productive when watered and fertilized
- Wait to plant when really warm (late April)



Cucurbits: Cucumbers, Pumpkins, Squash & Zucchini

- Quick and easy to grow from seed
- Winter squash are grown during summer!
- **Common question:** Plants have been blooming for a week but no fruits – why?



Female Flower

Young fruit -
Cucumber



Male Flower



Cucumbers, squash, zucchini, melons, pumpkins – male flowers produced first few weeks, typically more male than female flowers

Melons

Wait until really warm to plant

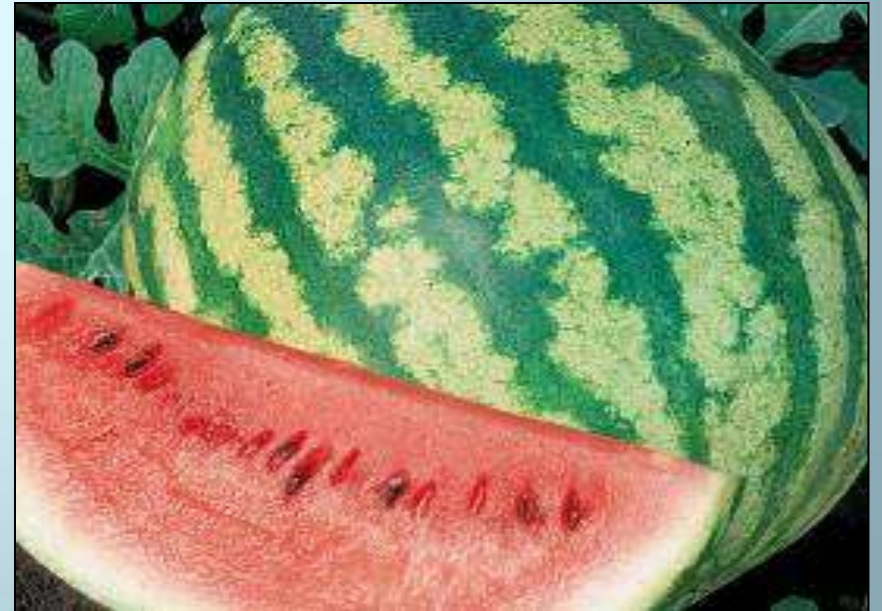
Cantaloupe

- Prefer drier conditions
- More compact vines, space 3'
- More leaf disease problems than watermelons



Watermelons

- Need consistent moisture
- Space 6'-8'
- Seedless varieties are expensive
- 'Crimson Sweet', 'Jubilee' – reliable, seeded



Melons and cucumbers can climb!



Sweet Corn

- Plant early April
- In blocks of at least 3-4 rows
- **Wind pollinated**
- Stagger plantings every 2 weeks – later plantings will have more problems with corn earworm
- **Drought sensitive!**



Sweet Corn

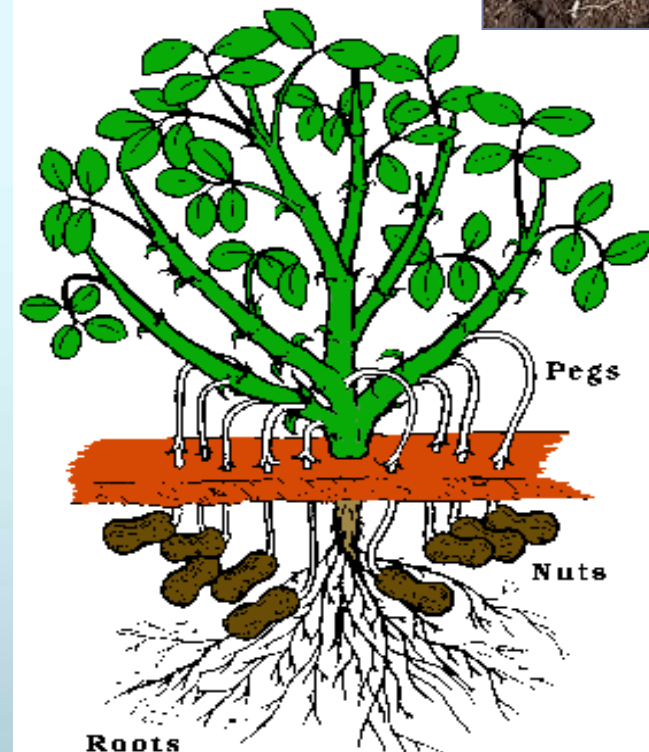
- **Sugary Varieties (SU1)**
 - Traditional – sugars break down quickly
 - Silver Queen, Seneca Chief
- **Sugary Enhanced (Se)**
 - Higher levels of sugar
 - Bodacious, Legend
- **Super-sweet Varieties (sh2)**
 - More sugar than SU1 and does not break down rapidly
 - Serendipity

These are not GMO!



Sweet Potatoes and Peanuts

- Need well drained, sandy soil
- Very frost sensitive
- **Sweet potatoes** need a lot of space!
- **Peanuts** form on 'pegs' that grow into the ground from flowers on lower stems
- **Deer love both!**



Beans and Their Relatives

Beans-Lima, Butter, Green

- Can inoculate seed with nitrogen fixing bacteria
- Don't bear heavily in hot weather
- Bush and pole varieties

Southern Peas

- Field Peas, Black Eye Peas
- Need warm soils
- Low bushy plants



Perennial Crops

Asparagus

- Plant crowns in early spring
- Well amended soil
- Wait 2 years to harvest
- Harvest spears in spring
- Overharvest = small spears
- Male 'Jersey' varieties more productive



Next Week:

Managing Pests & Weeds

- Insects and other critters
- Plant diseases
- Weeds

Evening Class

- Tuesday, March 22, 6:30-8:00

Morning Class

- Wednesday, March 23, 10:00-11:30



Bring soil samples
and forms for
delivery to lab



Questions?