Pre quiz

1. The walls of a raised bed can be made of:
    1. Wood, because it drains better
    2. Brick, because it stands up to desert dryness
    3. Concrete block, because it is affordable
    4. Any of the above can be used

1. (true/false) All corn grown and sold in the USA has been genetically engineered

3. They are grown for roots. Sweet potatoes are cool season/warm season (select one)

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Continued

4. “Buttoning” refers to a problem in
    1. Members of the broccoli family
    2. Members of the tomato family
    3. Members of the corn family
    4. Members of the squash family
5. (true/false) Blossom end rot occurs only in tomatoes

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VEGETABLES & other herbaceous annuals

and some plants we treat as annuals

Angela M. O'Callaghan, Ph.D.
Social Horticulture Specialist
University of Nevada

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The goals of this class

- identify different plant parts
- understand how climate affects vegetable growth.
- advise others about building and maintaining gardens

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What's a vegetable?

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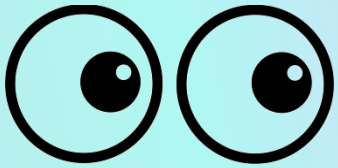
Foreword

Aside from the fact that we are more interested in eating them than in looking at them, vegetables have much in common with other herbaceous annuals.



Some annuals

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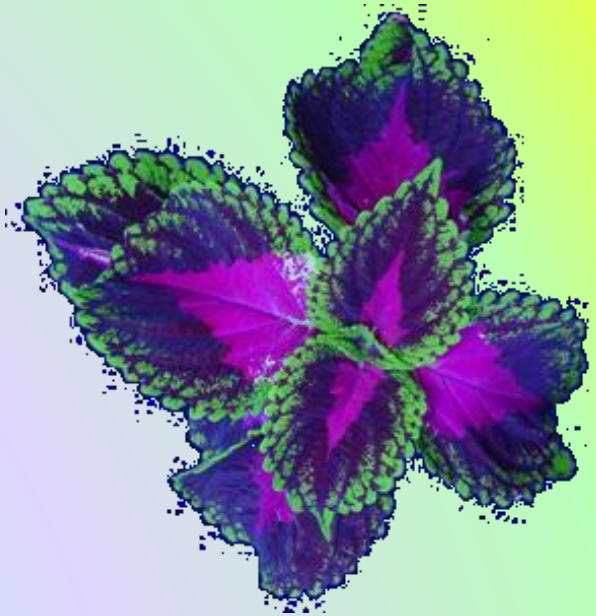
Main Difference

Ornamental annuals - often grown close together for a dramatic visual effect.

Vegetables - usually grown with more space between plants to maximize yield.

Ornamentals



Generally

- Leaves
- Flowers
- Bark
- Unusual or attractive growth habit

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Herbaceous Annuals

Definition

- Herbaceous: non woody, i.e. no secondary xylem
- Annual: seed germinates, produces roots and foliage, followed by an inflorescence and flowers, it then sets seeds and the parent plant dies. (monocarpic)

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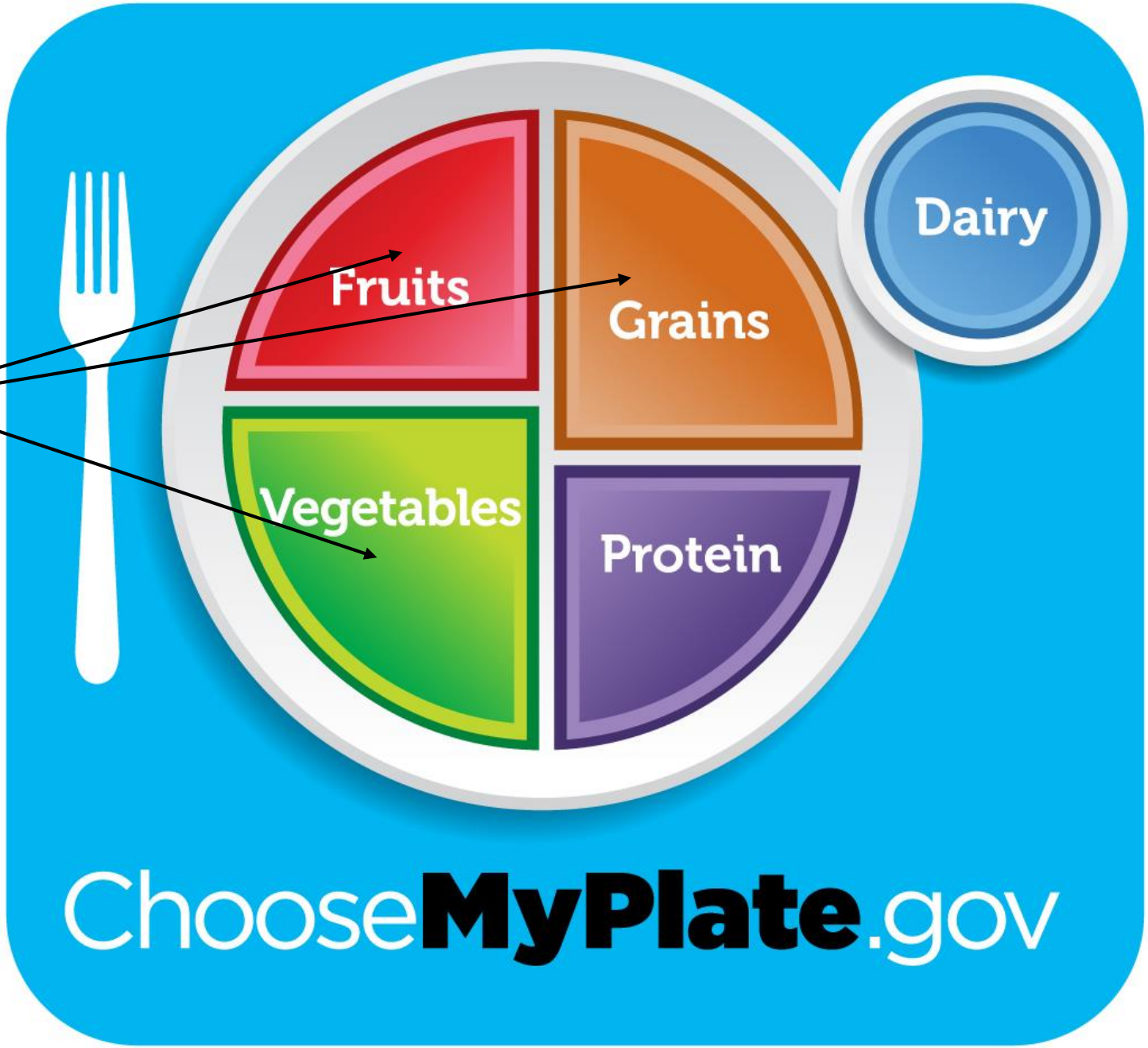
Why bother growing vegetables?

What can one grow in a garden?



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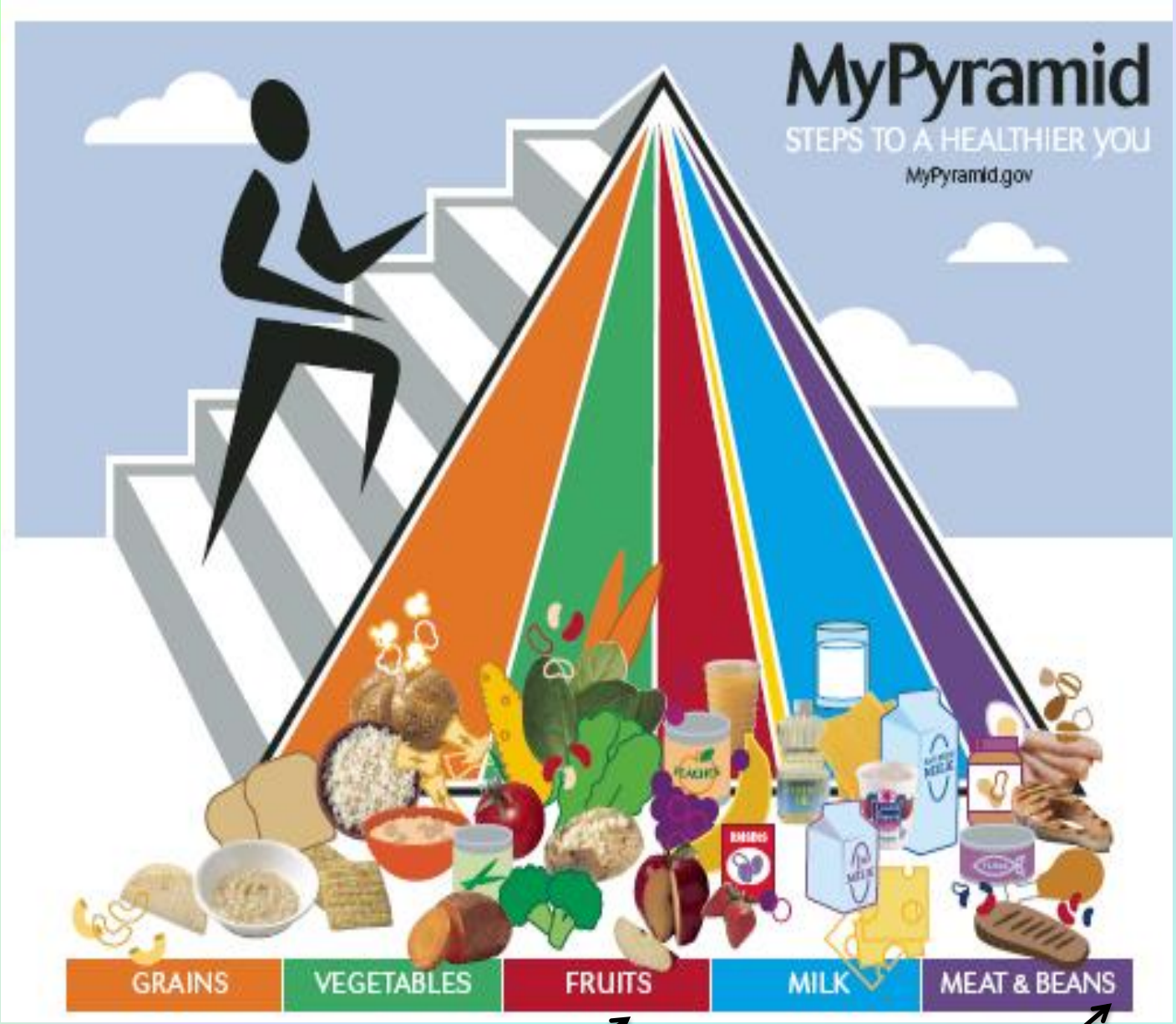

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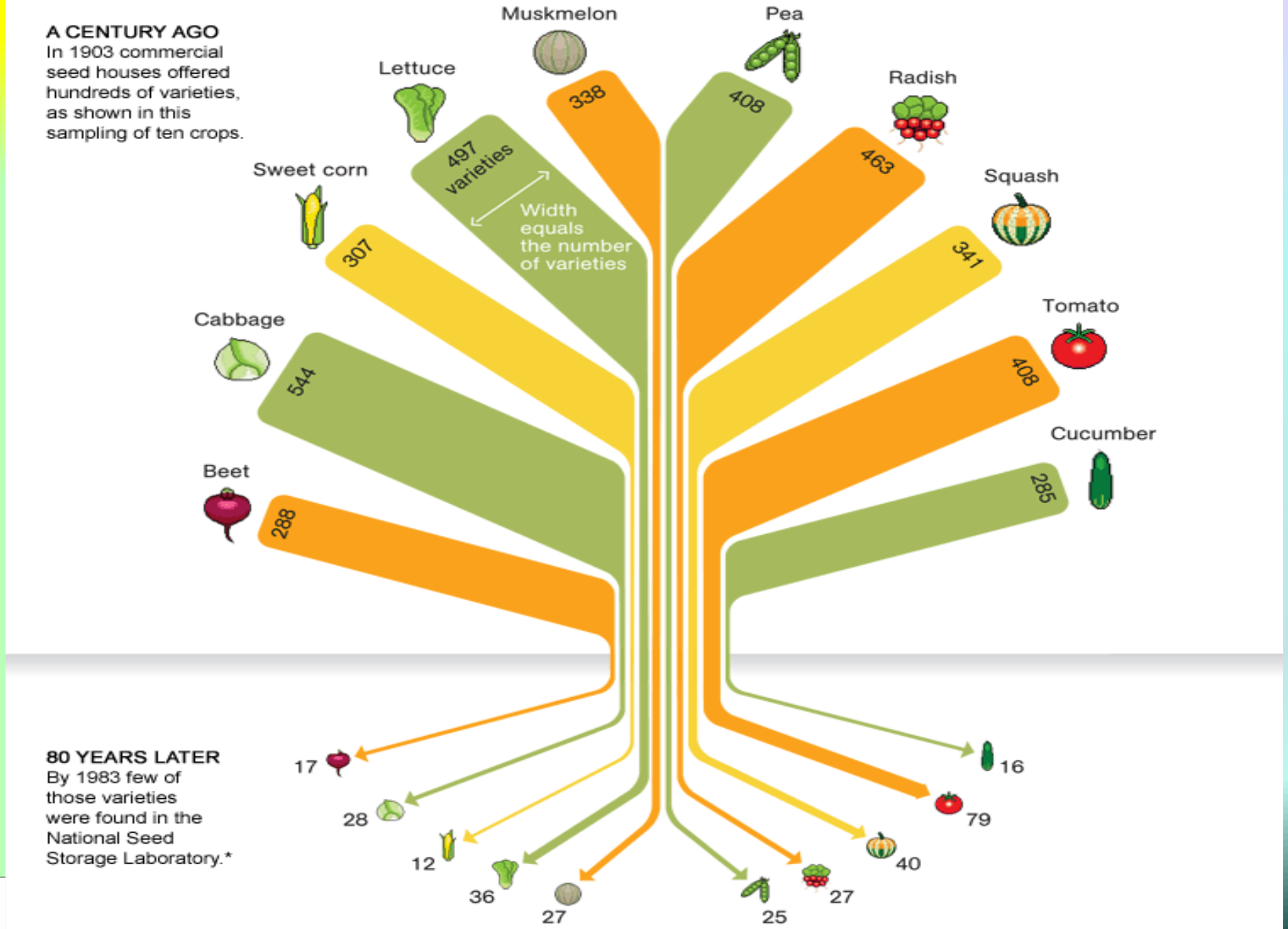
All too often,

WHAT DO STORE-BOUGHT VEGETABLES TASTE LIKE?

Besides taste, why bother?

- Commercial agriculture has concentrated on growing a few reliable vegetables
- This has led to a loss of genetic diversity



* CHANGED ITS NAME IN 2001 TO THE NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION

JOHN TOMANIO, NGM STAFF. FOOD ICONS: QUICKHONEY
SOURCE: RURAL ADVANCEMENT FOUNDATION INTERNATIONAL

What do we know?

- Almost any plant part can be a vegetable
- Although not often eaten for sweetness, they may have a fairly high sugar content
- Most are *grown as* annuals
- Most come from herbaceous plants

Vegetable crops
(and some related ornamentals)

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Vegetables and other plants can be classified as either

COOL SEASON

WARM SEASON

Refers to when they are planted

Cool season (night temps > 40 °)

- Grown for ***pre-floral*** organs
- Require at least 6 hours of light daily
- Need protection from hot, bright sunlight.
- Plant from ~ February to early April and mid September through October (usually)

Plant Parts

Leaves

garlic and onion are leaf tissue!

Plant Parts

Roots

STEMS – ASPARAGUS (perennial)

Bulbs

- Onions and members of the allium family

Plant Parts

Tuber - swollen underground stem

(stolon)

Plant Parts

Petioles

Edible Plant Parts

Sepals

(Artichokes are perennial)

Edible Plant Parts

Branched inflorescence;
Pre-flower stalk

Flowering broccoli)

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Specific crops *Broccoli*

- Cool season biennial
- Requires high N inputs
- Plant in early spring or late summer
- Heads develop more rapidly at high temperatures.

Requirements
Similar to broccoli

- Cabbage
- Cauliflower
- Brussels Sprouts
- Kale
- Turnips

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Edible Plant Parts

Cauliflower is not a flower!

Pre-floral structure;

Shoot meristem (undifferentiated growing tissue)

Brassica oleracea var. *botrytis*

Ornamental kale

Chilling helps produce colors in biennial kale, which is edible, but not so tender or tasty as the standard variety.

Broccoli problems

- If transplants are too large, very small heads form
- = “Buttoning”
- Aphids are the major insect pests

Specific Crops

Carrot

Daucus carota

- Grow on many soil types, if there is proper drainage and the soil is loose and deep enough for the tap root to develop.
- Cool season biennial

Carrots
Four main cultivar types

Imperator: 7 – 8” long with 1 – 1.5” shoulder

Danvers (“half long”): 6 – 7” long with 2 – 2.5” shoulder

Nantes: Almost completely cylindrical

Chantanay: 4 – 5” long with a 2 – 2.5” shoulder

In addition to others, e.g. globe shaped

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Carrot (cont.)

- Drainage is critical
- Water reaching the growing tip will cause deformation and rotting
- Carrots are biennial; if they experience winte, they will bolt

Not many problems here, but

Aster Yellows phytoplasma can cause “hairy root” which looks something like this

Although they are roots, don't forget to thin members of this family!

Similar requirements

Coriander, parsley

dill

parsnip

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Lettuce *Lactuca sativa*

- Cool season, annual crop
- May form loose (Boston type), tight (crisphead/ iceberg) or loafshaped (Romaine) heads, or be a leafy type.
- Leaves form in rosettes

Lettuce (cont.)

- Quick growing (~45 days from seeding to young head)
- Easy to produce in sequential plantings
- Plant directly or use transplants
- Requires high nitrogen, i.e. grows best on rich soils
- Has a tap root, but generally a shallow root system (~18” deep)

Lettuce (cont.)

- Will bolt (produce an inflorescence and flowers) if temperatures > 80º. Some varieties also require long days (short nights).
- Tip burn (calcium deficiency) occurs when temperatures are > 70º if plants are irregularly watered
- If seedbed is too warm, seed germination may be inhibited.

Lettuce tip burn
analogous to blossom end rot

Lettuce

Has some pests

Galls on roots indicate root knot nematode infestation.

Powdery mildew

Green peach aphids

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Ornamental & Leafy members of Asteraceae (many are edible!)

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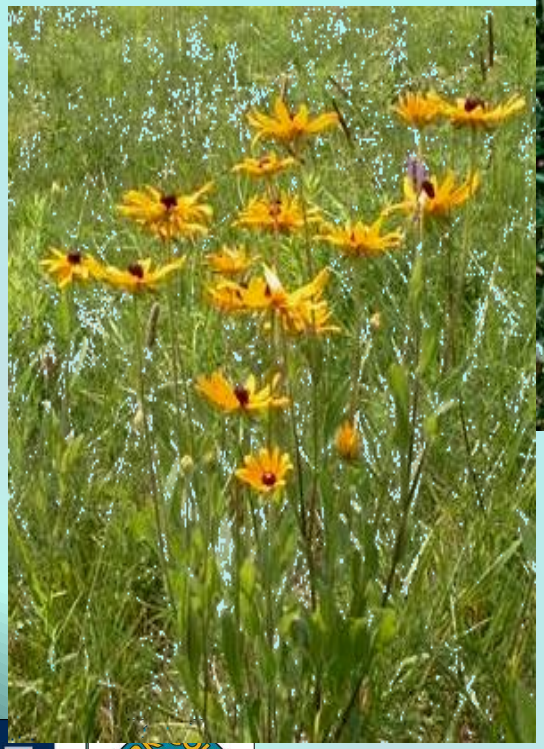
Weeds in the same family as lettuce

Black eyed susan



dandelion

thistles

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Sequential plantings

- Ongoing fresh crop of plants
- Some plants are only used fresh
- For instance, leafy greens
- For an ongoing supply, determine:
  - time from planting to mature plant
  - amount planted at any one time
  - How long plant(s) will stay usable

Calculate

- How long from seed to mature plant?
- How long will a first crop last?
- How much of a variety does the gardener (and household) eat?

Example

A salad green takes 45 days from seeding to maturity at 60° (early spring)

- Plant on February 1
- Plants mature about March 18, but can begin eating on March 13
- If one planting yields 14 salad days, by March 27, first crop is finished.

Example (cont.)

- Want to have continuous salad
- Need new crop by March 27
- At 75° plants grow faster, say ~ 42 days to maturity
- Count backwards 6weeks from March 27
- Begin planting by February 13

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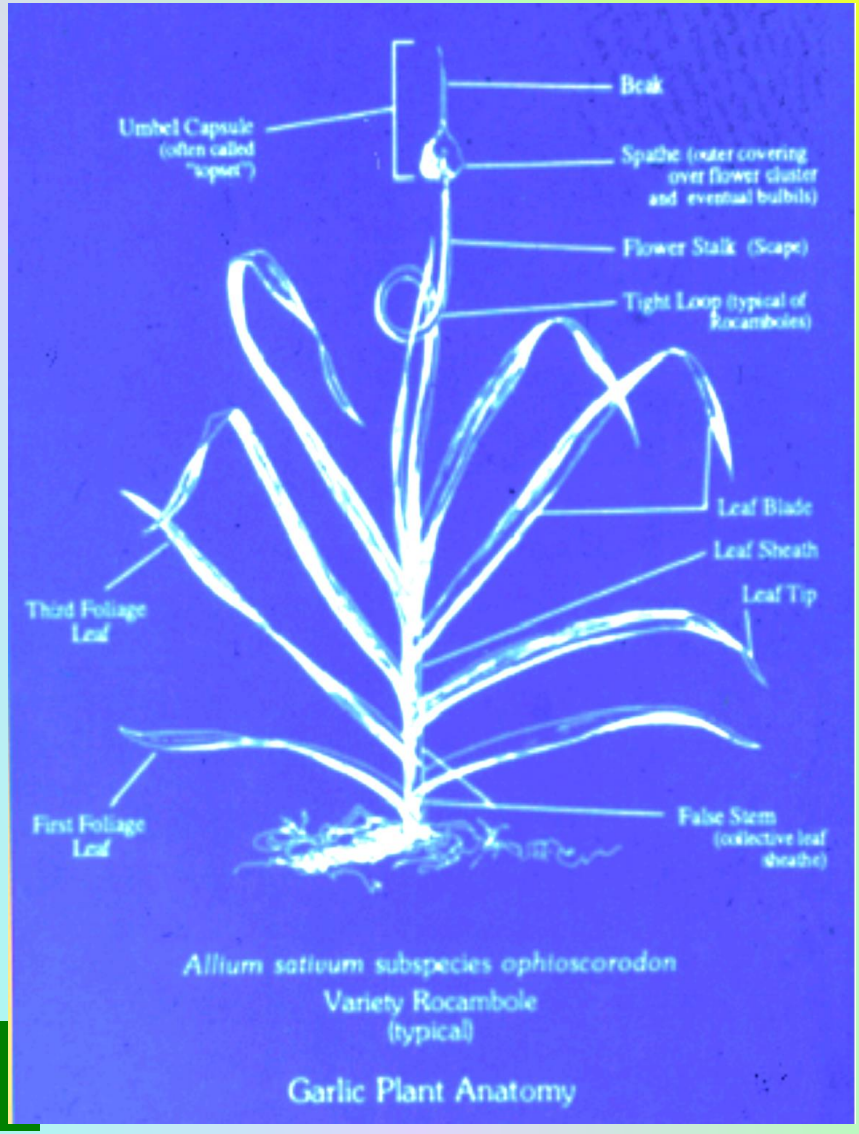
Specific Crops Garlic

- Cool season biennial
- Sterile
- Prefers loose soil
- Minimum pH – 6.2
- Cloves planted in fall, bulbs harvested early to mid summer
- Requires nitrogen early in spring, but does not use it efficiently after bulbing begins



Allium sativum

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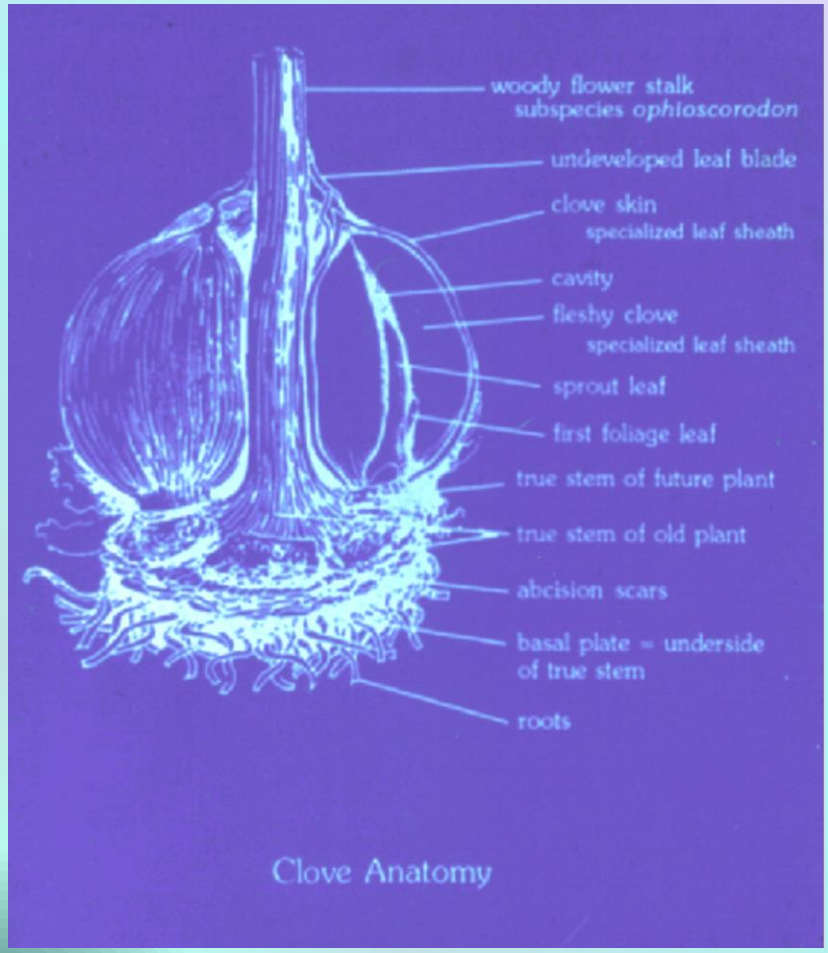
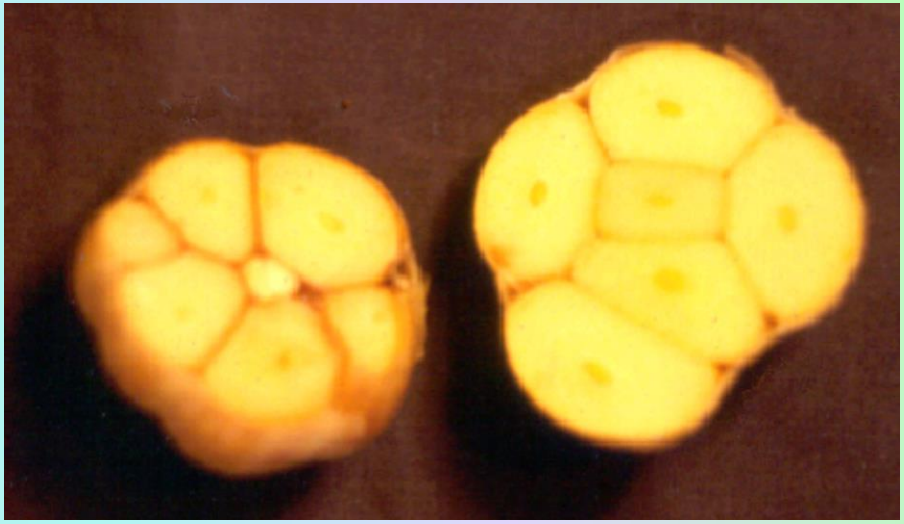
2 subspecies



Topset: always produces a flower stalk

Softneck: rarely produces a flower stalk



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Garlic does not produce seeds "Apomictic"

- 1 planted clove ⇨ 1 bulb
- Larger clove ⇨ larger bulb
- Requires chilling for bulbing
- Cloves planted in fall, bulbs harvested in mid summer
- Requires nitrogen early in spring, but does not use it efficiently after bulbing begins

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Garlic problems

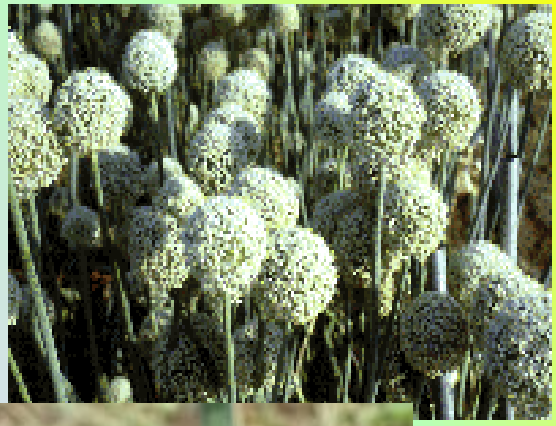
- **Plant only healthy cloves**
- ***Fusarium***: problem in hot dry areas. Causes basal plate rot, and whole plant turns chlorotic, then necrotic.
- **White rot** (*Sclerotium cepivorum*): problem during cool times. Attacks bulb and root. Leaf symptoms include wilting and dieback.
- **Aphids** carry viral diseases
- **Thrips** (*Thrips tabaci*) decrease yields late in season

Onions

- Long day plant
- For scallions, day length not so important
- Varieties are adapted to local conditions
- If chilled, may flower and produce seeds (bulb ruined)

Other alliums

biennials



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Break

Warm season (night temps > 50 °)

- Grown for flowers, fruits or seeds.
- Need at least 8 hours direct sun
- Even these do not grow well at temperatures above 95 °

Plant Parts

Many (not all) flowers are edible, although it's not common to use them in western diets.

http://www.extension.iastate.edu/Publications/RG302.pdf

http://www.ext.colostate.edu/pubs/garden/07237.html

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Plant Parts

Fruits

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Plant Parts

Seeds

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Tomato

Solanum lycopersicon

- The most popular vegetable crop in the world
- Comes in wide range of colors, sizes and shapes
- Adapted to many climates

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Tomatoes & temperature

- Optimum production at 70º-85º (day) and 65º-68º (night) for many cultivars, but this is highly variable
- Earliest varieties will produce between 40º and 50º day
- At high temperatures, red tomatoes may display orange hue as production of lycopene (red pigment) slows

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Herbaceous (non woody) plants grown for fruits may have different growing patterns

***Tomatoes** may be <u>determinate</u> (fruits ripen earlier) or <u>indeterminate</u> (fruits are more shaded, ripen later)*

Determinate (bush)

- Stem ends at flower cluster
- Stem produces no further leaves or flowers (“self pruning”)

Determinate – less leaf cover – fruits tend to ripen at once

www.casperstartribune.net/ garden/bills.php

Indeterminate (vine)

Stem produces

1. leaves
2. inflorescence
3. more leaves

Indeterminate – more leaf cover – fruits ripen in succession

www.ces.ncsu.edu

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Tomatoes (cont.)

- Usually produced as transplants
- Self pollinate
- Should not be crowded
- Need air circulation
- Prefer rich soil
- Must be watered regularly

- Tomatoes require large inputs of mineral nutrition
- Do not fertilize with nitrogen once flowering has begun

Fertilization

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Cultural practices

To maximize yield, some growers remove suckers from vining tomatoes

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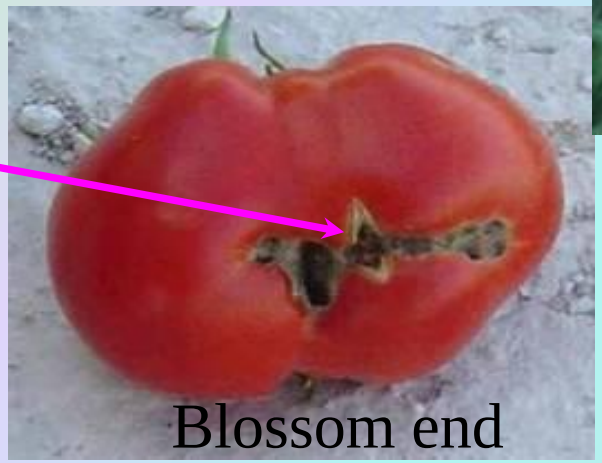
Problems

Catfacing – Temperatures too low. This is not the same as Blossom End Rot

Blossom end rot



Blossom end

Top of tomato

Radial cracks from *drying followed by high moisture*. Followed by pathogen attack.

Disease problems

- Modern varieties have resistance to common disease problems.
- Seed pack will have at least some of these letters:
  - V = Verticillium resistant
  - F = Fusarium resistant
  - N = Nematode resistant
  - T = Tobacco mosaic virus resistant
- Most diseases are rare in dry climates.

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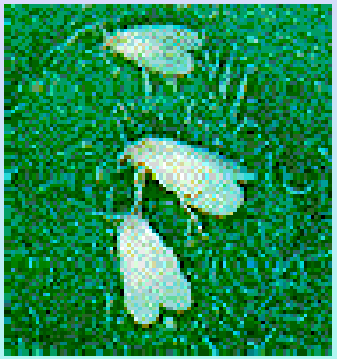
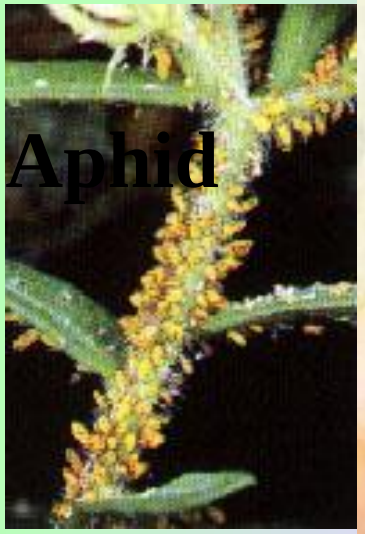
Insects of tomatoes

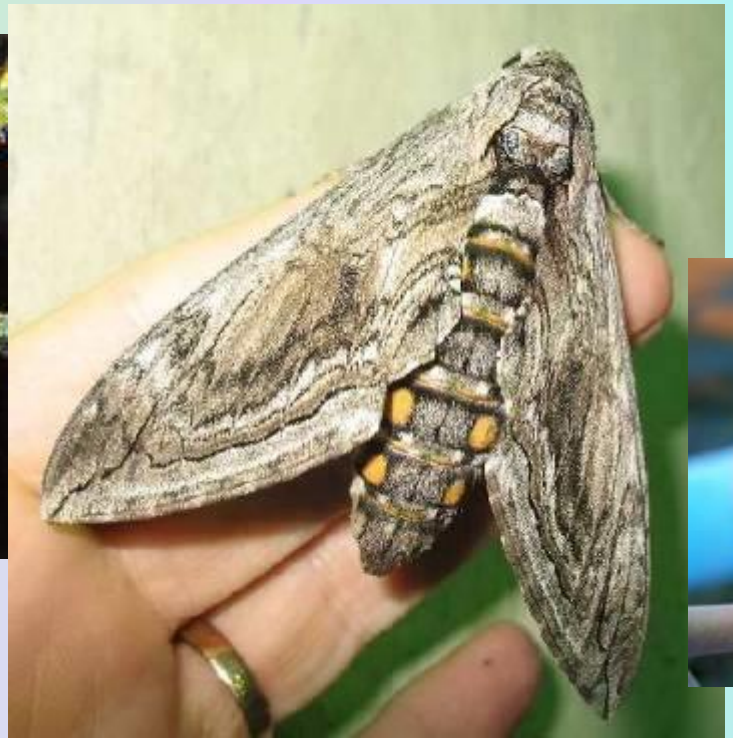
Whitefly
Silverleaf
Sweet potato



Tomato (or tobacco) hornworm
(hawkmoth larva)

Aphid





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Tobacco horn worm destruction!

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- tobacco hornworm - seven diagonal lines on its sides

- tomato hornworms - eight V-shaped markings

Control of hornworm

Biological

- Trichogamma wasp
- Bt

Physical

- Pick off at night when they most active
- Till planting area to chop any pupae in the soil

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Specific crops Peppers

Capsicum frutescens

- Cultural practices and needs are similar to tomatoes, but tolerate and require higher temperatures – 75º - 86º
- Pollination required for proper fruit shape

Capsicum annuum

Peppers (cont.)

- Flowers may abort with very high temperatures, low light levels, or drought stress
- Blossom end rot appears after irregular watering
- Under low temperatures, fruit may be deformed (flattened shape)
- Insects and diseases are similar to those in tomatoes

Ornamental solanaceae

Why

do tomatoes taste (or not taste) the way they do?

Hint: Think about shipping

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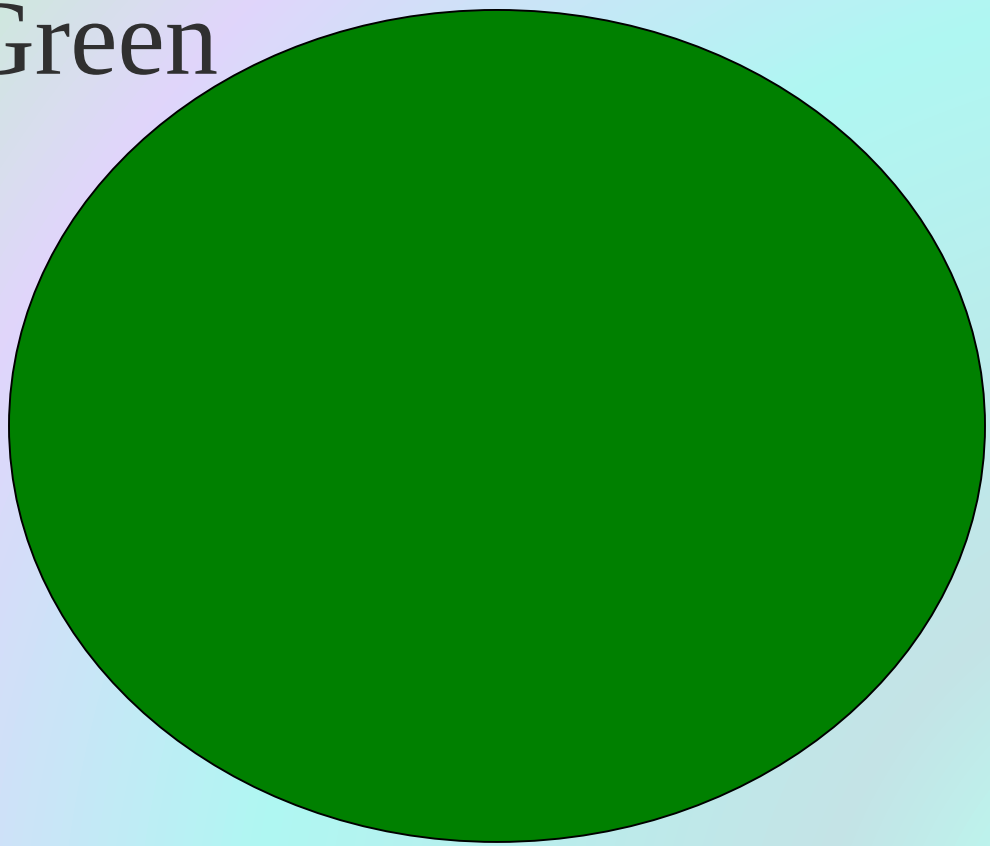
Stage 1

Immature Green



Will never ripen

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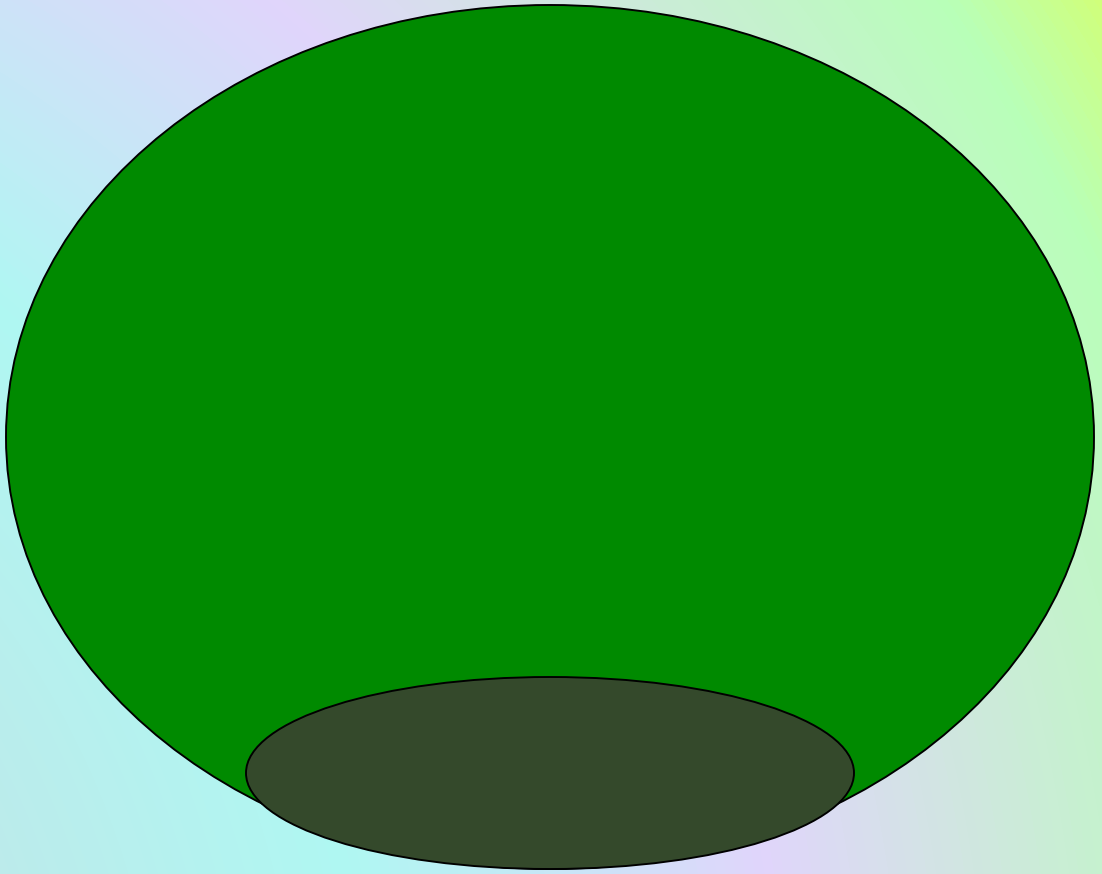
Stage 2

Still hard, but can ripen if picked at or after this stage

Mature green

Looks just like immature

Stage 3

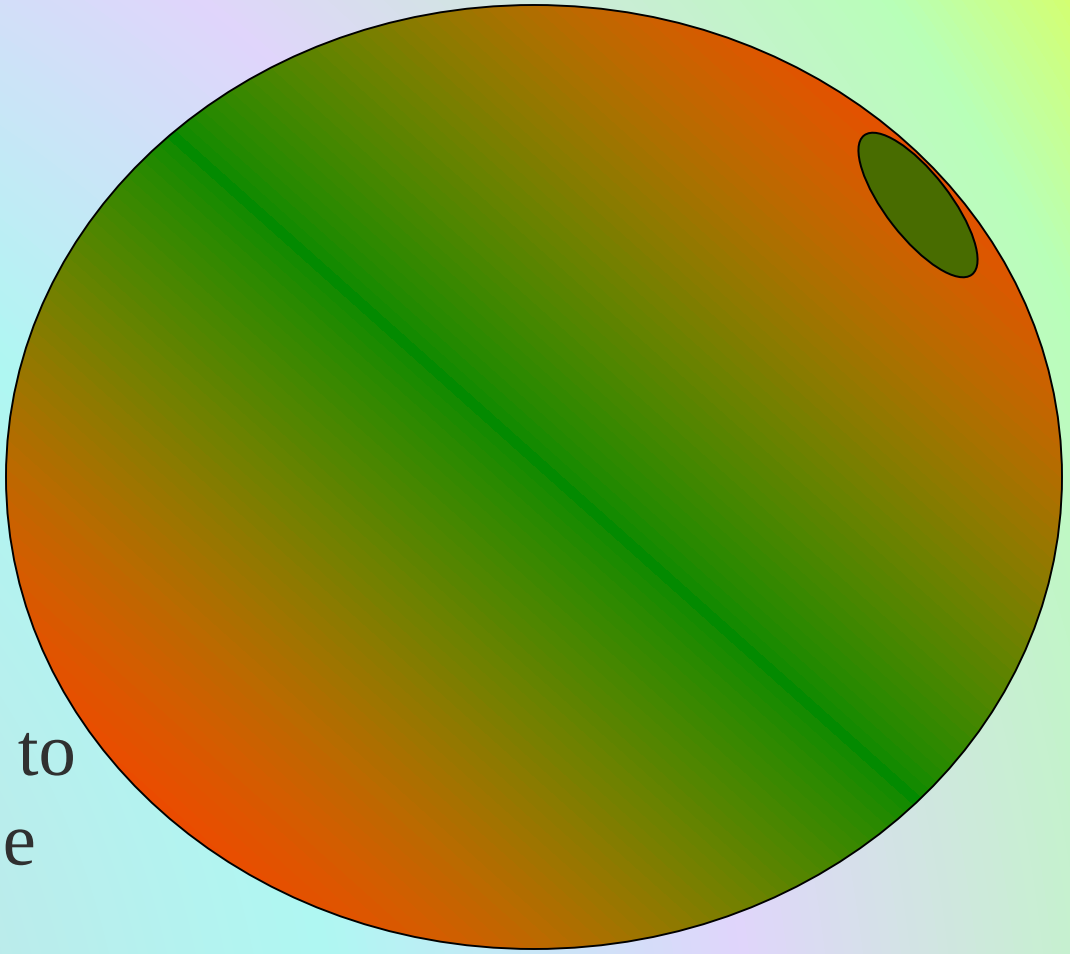


Breaker

Becoming ripe

Stage 4

Pink

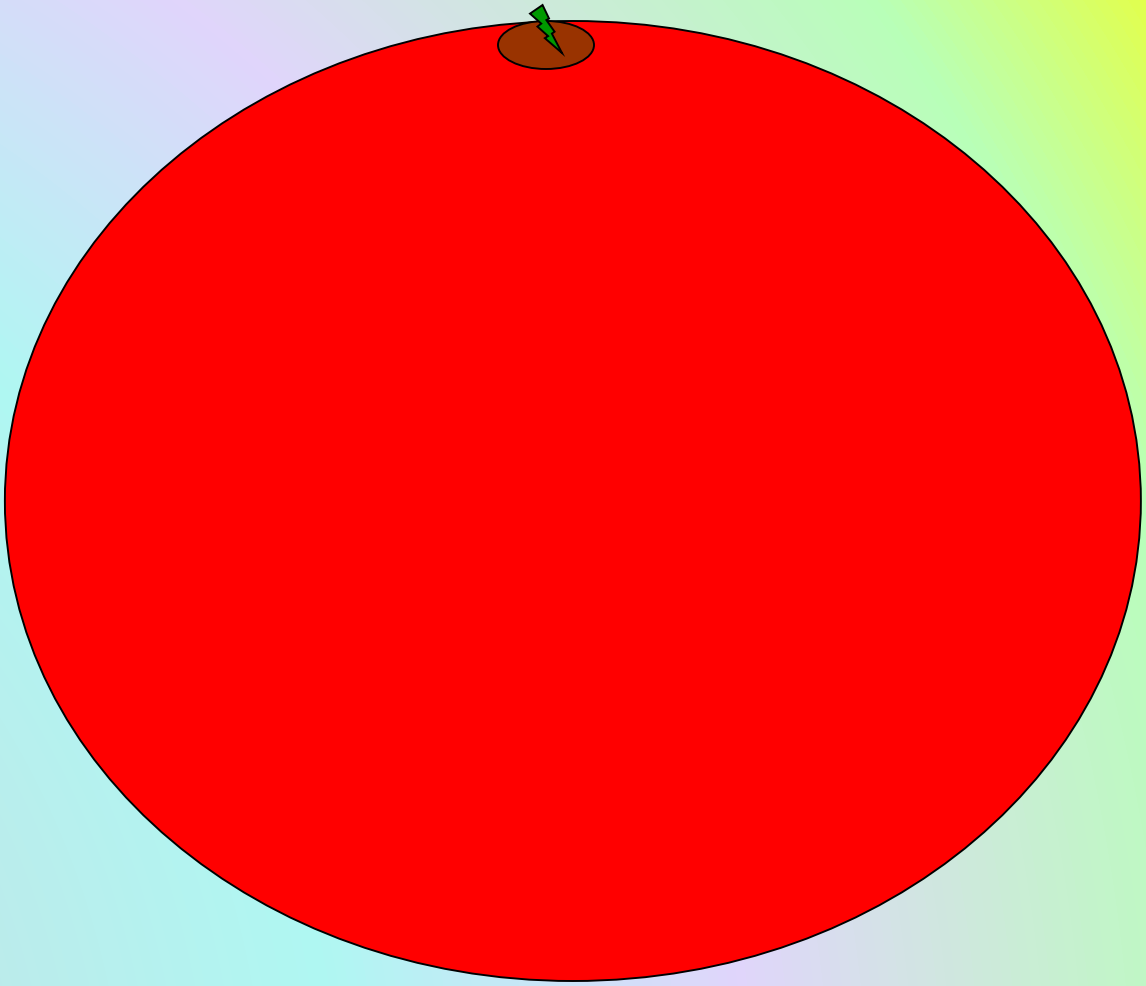


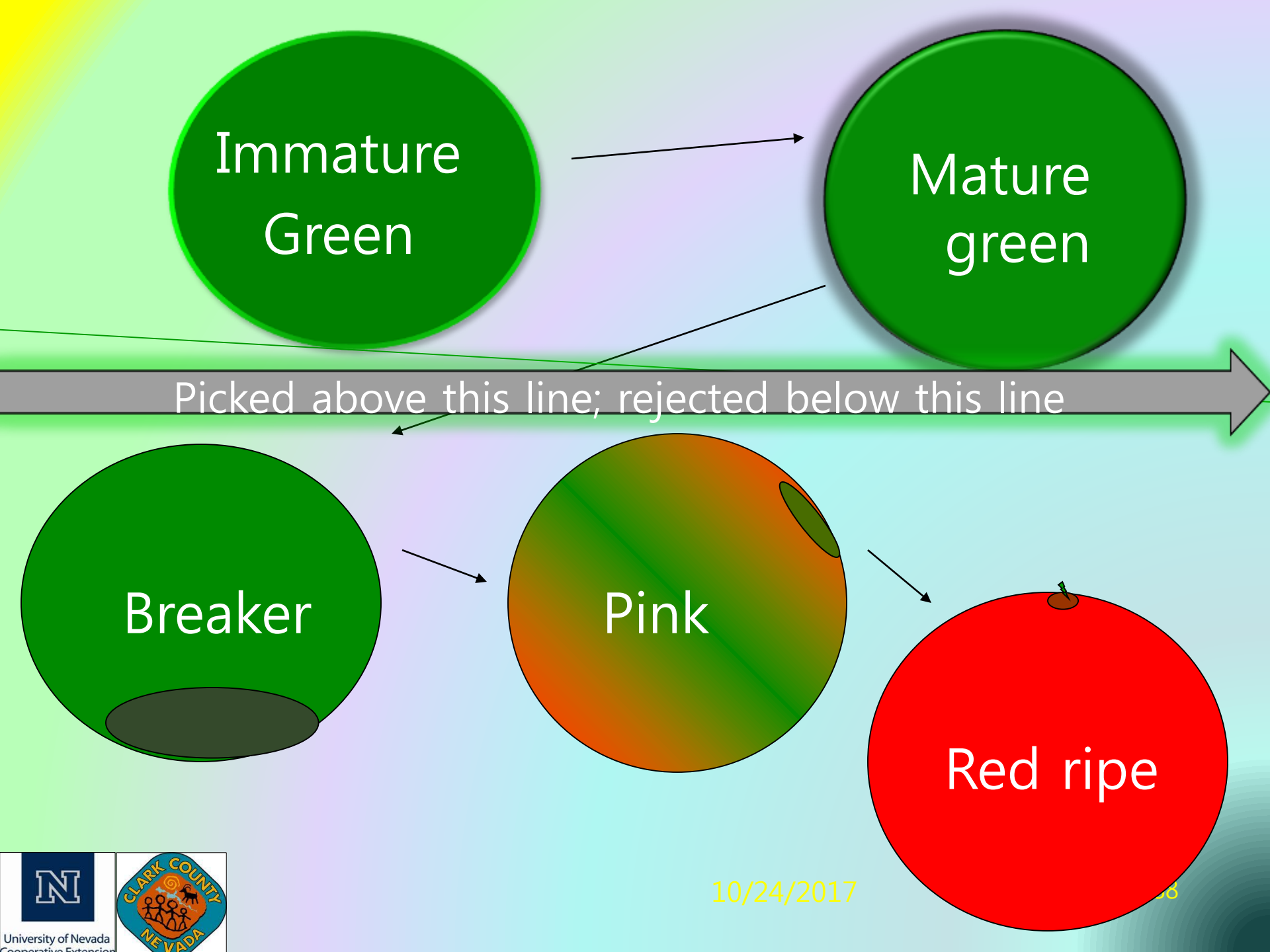
Well on its way to being fully ripe

Stage 5

Red ripe

Delicious; doesn't travel well




Immature Green
Mature green
Picked above this line; rejected below this line
Breaker
Pink
Red ripe

Look for gel in locules

Specific crops **Sweet corn**

- Warm season annual
- Many varieties, colors & sizes
- Temperature most important for ear formation
- Produces best with warm days and cool nights.

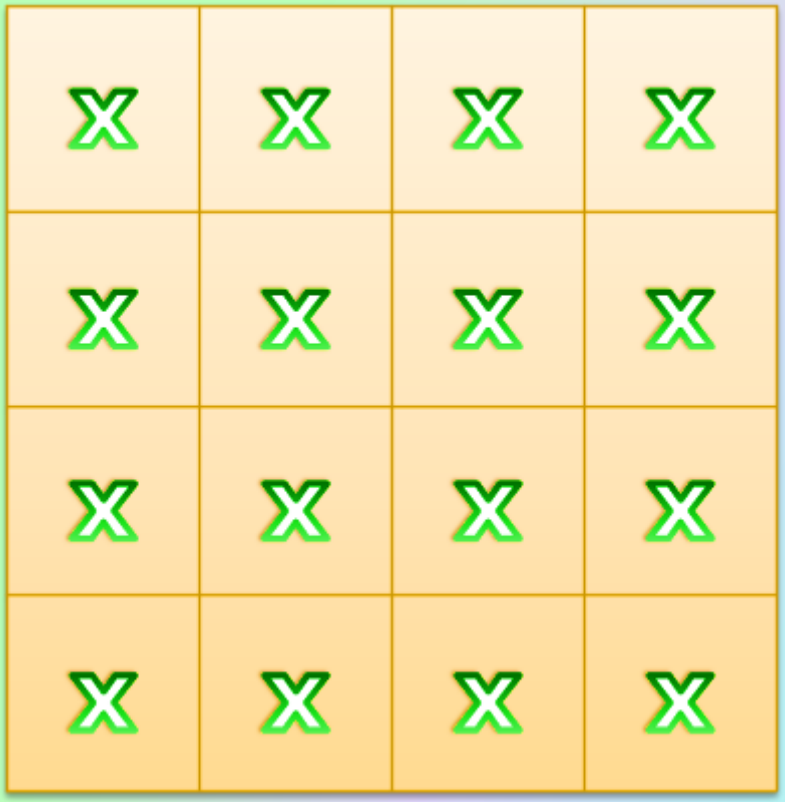
Corn (cont.)

- Plant is monoecious (male and female flowers on same plant)
- Male flowers - tassels at top
- Female flowers - spikes that become ears
- "Silk" is the pollen tubes (style & stigma)

Corn (cont.)

- Spacing depends on whether full size or dwarf variety
- **Must** be planted so pollination can occur

Corn (cont.)



- Wind pollinated
- Minimum of 4 x 4 plants so pollination can occur

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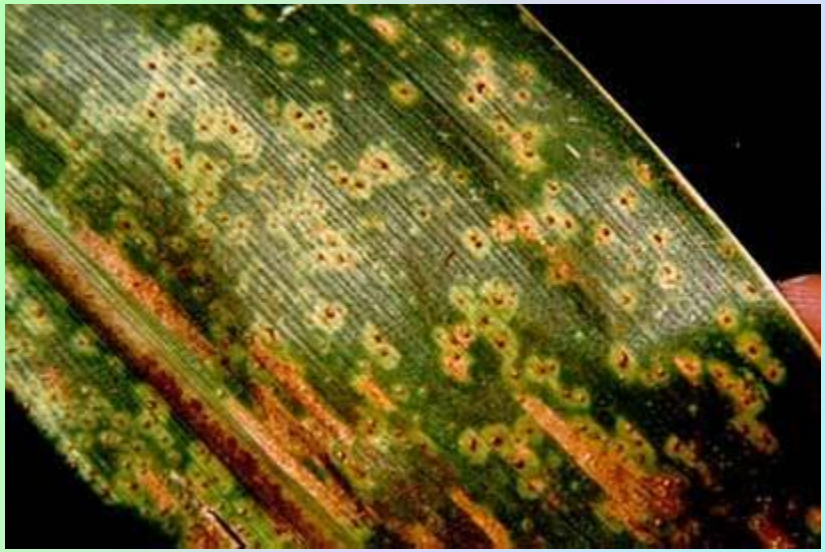
Supersweet corn

- Supersweets - poorer germination than other varieties.
- Sugar remains longer after harvest
- Ears can be **shipped** without becoming starchy

Corn diseases

Southern rust *Puccinia polysora*



Smut *Ustilago zeae*

Insects on corn

Corn ear worm

Heliothis zea

Corn flea beetle damage

Chaetocnema pulicaria

Corn borer

Diatraea lineolata

GMO corn

- 88% of US corn is genetically modified
- This has been mainly for field corn, but Walmart sells GMO sweet corn. Not Whole Foods or Trader Joe's
- The B.t. gene was introduced to combat European corn borer

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Ornamental grasses

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Sweet potatoes

Ipomoea batatas

- Warm season, tender perennial, grown as an annual
- Edible storage root
- Best pH ~ 6
- Best in sandy soil

Sweet Potatoes

- Vines grow if/when temperatures are warm
- Planting material is “slip” i.e. shoots that grow from root.

- Are NOT Yams!
- Are NOT Potatoes!
- Are closely related to morning glory!

Sweet potato problems

- Weevils
- Root knot nematodes
- Wireworm
- If pH is high, and if microorganism is present in soil, can develop “scurf”

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Other members of this family

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Canteloupe (muskmelon) & other melons

Cucumis melo

- Vine crop
- Warm season, tender annual
- Water uptake is severely limited at temperatures at or below 60°

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Melons (cont.)

Produce both male and perfect flowers on same plant:

- Males earlier in season
- Perfect as days are long
- Male flowers appear again late in season

Cantaloupe (cont.)

- Harvest only at “full slip”
- Heavy feeder of nitrogen and phosphorus
- Requires fairly high calcium and potassium
- Optimum pH ~ 6.8

Melons & powdery mildew

- Looks like talcum stuck to leaves
- Cause - *Erysiphe cichoracearum*
- Control with oils, water, sunshine
- Do not plant in shady areas

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Blossom end rot

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Other members of this family

Have similar requirements:

- Cucumbers (flowers: male, female, male)
- Pumpkins
- Squash
- Watermelons

Break

exceptions

Peas

- Grown for seed pods or seeds
- Require ***cool*** temperatures
- Require at least 8 hours of light

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Sweet potatoes – grown for roots, need ***warm*** weather

Photo by Miya, creative commons

MODIFIED STEM

Nopal – spineless cactus grown for modified stem, needs *warm* weather.

Obtaining the desired plant part relies on a number of factors, some of which interact…

Factors affecting development

- Light: **Amount**
  Duration
  Direction
- Nutrient levels
- Water (precipitation or irrigation)
- *Day* temperature
- *Night* temperature
- Pests: **insects**
  weeds
  disease

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Before creating a garden – ask:

- What are you interested in growing?
- How much space?
- What (if any) kind of soil?
- Easy access to water?
- How many hours of sunlight does the area receive?
- Direction of the light?
- What is level of time, strength & interest?
- Will there be help?

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Raised Beds

- Often best for vegetables
- Often best when soils are difficult to work
- Must be deep enough for drainage
- A convenient size (usually at least 1’ deep by 4’ wide.)
- Walls may be:

  Brick, Wood (not pressure treated), Plastic (but these do not last as long as expected)

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Raised beds (cont.)

- Use a rich medium with good drainage
  - Soil
  - Mix
- Most annuals require regular, careful watering – install irrigation
- Drip was invented for vegetables!

There are kits

Container Gardens

Plants may be grown in the field or in a pot, but a clay pot will tend to dry out much more quickly.

Glazed, foam or plastic - usually more stable in desert environment.

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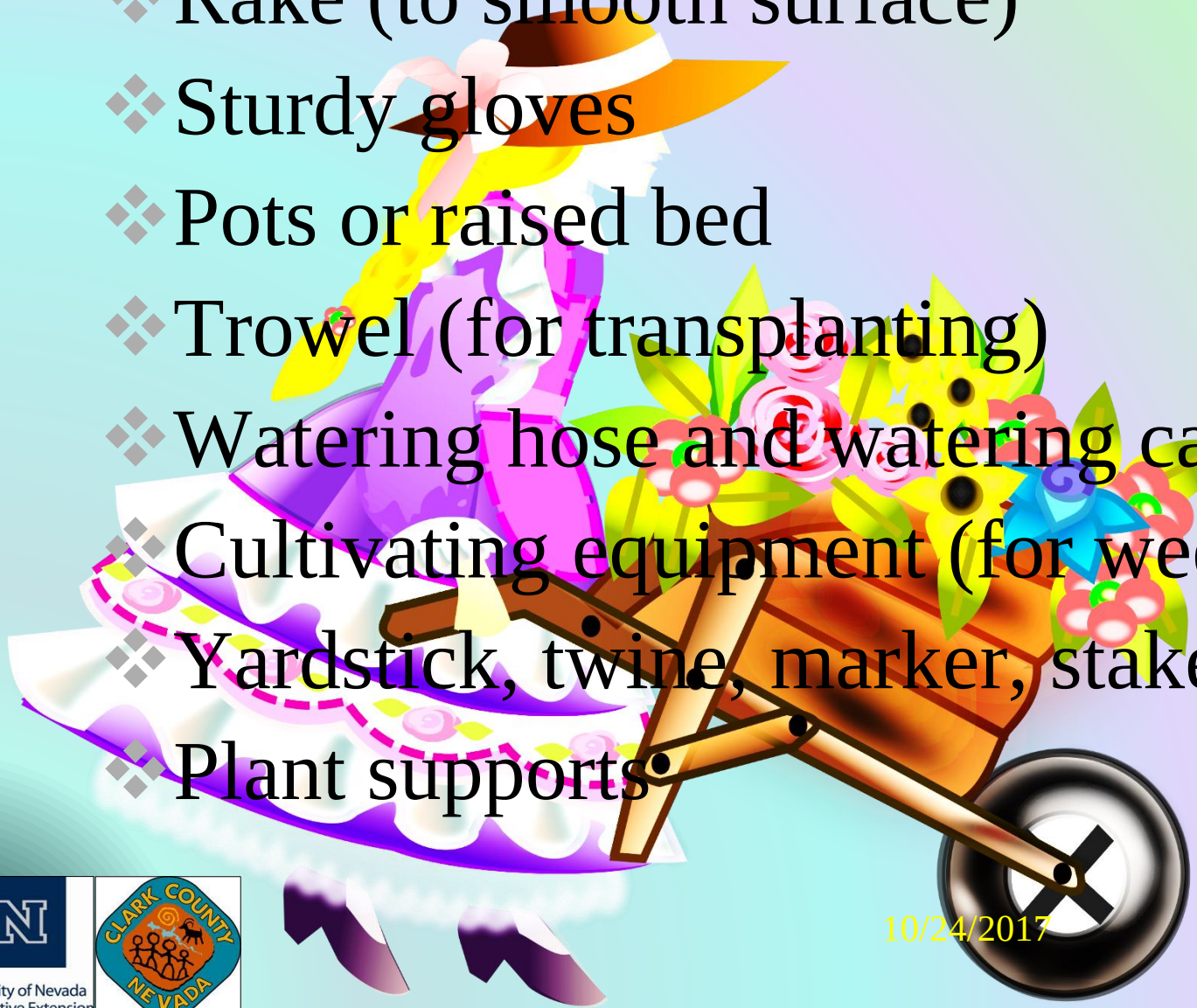
Tool kit

- Digging implement
- Rake (to smooth surface)
- Sturdy gloves
- Pots or raised bed
- Trowel (for transplanting)
- Watering hose and watering can
- Cultivating equipment (for weeding)
- Yardstick, twine, marker, stakes
- Plant supports



Healthy annuals often require fairly large inputs of nutrients

Plant Part Nutrient

- **Root** Phosphorus, Potassium, Boron
- **Stem** Potassium, Calcium
- **Leaf** Nitrogen, Magnesium, Iron, Molybdenum, Zinc
- **Flower** Phosphorus
- **Fruit** Phosphorus, Potassium
- **Seed** Phosphorus, Boron

But different plant processes need all the nutrients, so don't forget about providing them…

To provide essential nutrients

- Begin with an enriched soil or mix
- Add compost
- Improve soil pH if needed
- Grow in raised beds
- Add fertilizers (last resort)

Most vegetables are large water consumers

- Access to water is critical
- Scheduling watering is not so important as making sure that water is applied when necessary
- Some plant problems can be avoided with proper watering
  - Blossom end rot, leaf tip burn
  - Fruit cracking

Space

- Plan the garden based on what is being planted
- Seed packages have good information on the needs of each specific variety. Read!
- Make sure to have a deep enough bed to produce a healthy root system
- **Always make sure that there is <u>proper drainage</u>**

Proper plant development requires:

- Correct choice of starting material
- Correct nutrition
- Correct environment

Post quiz

1. The walls of a raised bed can be made of:
    1. Wood, because it drains better
    2. Brick, because it stands up to desert dryness
    3. Concrete block, because it is affordable
    4. Any of the above can be used

2. (true/false) All corn grown and sold in the USA has been genetically engineered

3. They are grown for roots. Sweet potatoes are cool season/warm season (select one)

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Continued

4. “Buttoning” refers to a problem in
    1. Members of the broccoli family
    2. Members of the tomato family
    3. Members of the corn family
    4. Members of the squash family
5. (true/false) Blossom end rot occurs only in tomatoes

Questions?