

## Hot Vegetables for a Cool Place

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**Our jobs: Grow new  
vegetable gardeners  
and grow our own skills  
as well**



## Motivations for vegetable gardening

- Freshness and quality
- Know how it was grown
- Do It Yourself
- Family traditions
- Unique varieties
- Financial reasons



## Other Reasons to Grow a Vegetable Garden

- Produce picked at the optimum stage of maturity
- Cultivars specifically suited to consumers' preferences
- Less transportation of commodity = reduced "Food Footprint"
- Food security



### The competitive gardening subculture



### We want new vegetable gardeners to succeed



- There is a high dropout rate for new gardeners - Why?
- How can we help them succeed?

### Some questions to talk about with new gardeners

- Who all will be doing the work?
- What does your family like to eat?
- How will you use the produce?
- How much space is available?



### A new gardener's choices

- Where?
- How big?
- Rows or beds? Containers?
- Weeds.....aaaargh!
- Which vegetables?
- Seeds or transplants or both?
- Fertilizer options
- Watering method



## Location and sunlight!!

6+ hours sunlight best - some crop options for less.

Located for ease of working and reminder that there is a garden

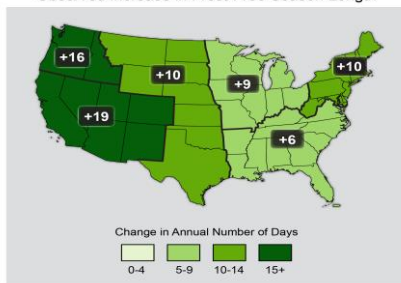


## Interaction of plants, climate, and weather

- Winter cold temperatures limit what can grow and when. But not as big a deal with vegetables since most are annual life cycles.
- Frost events are a wild card
- Heat influences growth rate and maturity (plus and minus)
- So does light intensity and day length
- **We can manipulate temperatures around our plants to take advantage of our generally mild, if rainy, winter through spring climate**



Observed Increase in Frost-Free Season Length



## Frost (32 degrees) intervals

Location	Spring date	Fall date	Climate change dates
Portland	4/20	10/31	New 4/12 and 11/07 ?
Vernonia	5/15	10/05	New 5/07 and 10/13 ?
Astoria	4/09	11/07	New 4/01 and 11/15 ?
Tillamook	5/01	10/08	New 4/23 and 10/16 ?

Killing frost: 15-20 days earlier for the last 28° temperature in spring and 15 days later for the first one in the fall.

Remember: These are averages, not absolutes!!

## Vegetable frost hardiness

- For vegetables that are frost hardy, there is a continuum both between species and varieties within species.
- Hardy: Most of cabbage family, garlic, onions, peas, some lettuces, chard, carrot family, etc.
- Non hardy: The subtropical plants like tomatoes, peppers, eggplant, most squashes, basil, cucumbers etc.
- Fall frosts can make some vegetables sweeter; some can overwinter



## Growing degree days aka "heat units" 4/01-10/31

- Astoria 1438
- Kelso 2004
- St. Helens 2586
- Vernonia 2050
- Hood River 2552
- The Dalles 3267

GDD =  $\text{High temp} + \text{low temp} / 2 - 50$

Example:  $58 + 50 = 108 / 2 = 54 - 50 = 4$  GDD



Black Kim: Courtesy Loghouse plants

## Growing degree days (Base 50 degrees)

- Scappoose from April 1 to October 31st:

- 2016 2182 GDD
- 2015: 2954
- 2014: 2770
- 2011-14 average: 2294

- 4/1-5/12 DD

Year	SH	Ver	Rain	Scap	Clat
2016	416	351	371	422	366
2015	278	219	232	280	225
2014	251	207	190	260	203
2013	288	262	241	303	250
2012	185	162	182	191	134



## Crop implications of increased frost free days and more heat units

- Earlier transplanting and/or seeding of frost sensitive crops (assuming soil drainage is ok).
- More rapid early growth and longer growing season – more yield?
- Combined with the greater heat units, more crop options



### Daylength effects

- Longer days = more sunlight
- Cloudy vs sunny days affects plant growth and development
- **We need to take as much advantage as possible of the long days in the spring**
- Day length changes can trigger floral bolting or other plant processes like bulbing
- Temperature also play a role in bolting
- Sub-tropical plants **not** daylength triggered for flowering (tomatoes, peppers, beans, etc.)



### Other day length and/or temperature effects

- Bolting or flowering
  - Onions
  - Broccoli
  - Spinach
  - Lettuce
  - Cilantro
  - Artichokes



### Temperature

- **Cool season crops**
  - Can grow at <50°F but better if 65-75 °F
  - Tolerate light frost.
  - Quality may deteriorate under hot conditions.
  - Peas, spinach, crucifer (cabbage family) crops
- **Warm season crops**
  - Develop best at temps >50°F.
  - Killed by frost.
  - Beans, tomatoes, peppers, eggplant, sweet corn, cucurbits.



### Light intensity effects

- The light quality and quantity profoundly influences plant growth
- Some plants are adapted to lower light intensities (lettuce, to some extent)
- We can grow greens in the winter (sort of) but not tomatoes or cucumbers due to low light intensity



## High temperature impacts on horticultural crops: sunburn

- Transpiration cooling of plants affected by high heat and/or moisture stress
- Cuke and pepper fruit tissue damaged at ~104-8°F skin temp.; apples at ~125° F.
- Sunburn or other quality issues
- Manage by irrigation, variety selection, planting dates, and sun-blocking materials

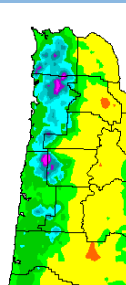
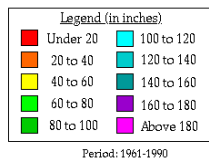


## Other high temperature impacts on horticultural crops

- Corn, tomatoes, and beans may not set fruit/seed consistently on days with temperatures over 92 ° F.
- Growth rate on most crops slow dramatically at temperatures above 95 ° F.
- Few lettuce varieties or other greens do well at temperatures near 90 °F.

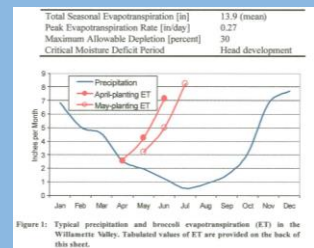


## Average Annual Precipitation Oregon



## Rainfall patterns

- Vernonia: 45-65 inches per year
- St. Helens: 35-45 inches per year
- **Most of the rain comes October through May**
- Summer rainfall is low: ~ 1.75" in July, 1.00" in August.
- Crop demand is 4-6" per month or more!



Broccoli water demand by month

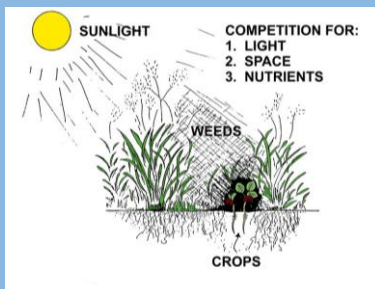
## Rainfall implications

- We have to irrigate!!
- Drainage is a big issue. Soil texture can profoundly affect irrigation needs in the summer and soil warming/cultivation timing in the spring.



## Non-irrigated vegetables

- Commonly grown without irrigation
  - Garlic
  - Rhubarb
- Looking at other crops
  - Winter squash
  - Tomatoes
  - Peppers
  - Dry beans
- Management issues



## Weed competition





Small seedlings are very vulnerable to shading!

The most important time to weed is the 3-4 weeks after planting your vegetable seeds



### Weed/crop interaction

<u>Crop</u>	<u>Weedy</u>	<u>Weeded</u>
Carrots	27 #s	503 #s
Onions	4 #s	68 #s
Potatoes	53 #s	148 #s
Cabbage	129 #s	233 #s



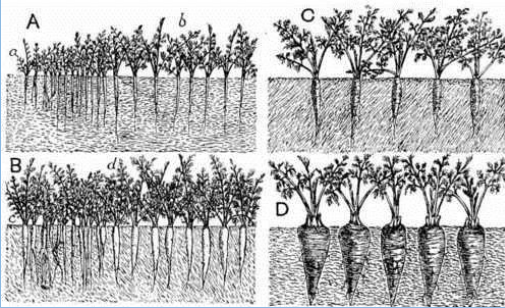
### Weed control timing is important



### Other competition affects quality







### Adding heat to your vegetables

- Transplants (also helps with weeding)
- Raised beds
- Cloches
- Floating row covers
- Hoophouse/greenhouse
- Walls of water



### So why might you love transplants?



### Virtues of transplants

- Heat embedded in their growth – start as the season is warming up
- More weed competitive
- Can get spacing right
- Earlier harvest
- Negatives
  - Expensive re labor
  - Specialized structure/equipment



### Transplant size

- Depends a bit on transplant conditions, i.e. potential transplant stress
- Generally, larger transplants will produce a crop faster.
- Crop uniformity
- Must be hardened off
- Row cover after transplanting
- Weed competitive



### Hardening Off

- Harden off to acclimate to
  - Wind
  - Intense light
  - Fluctuating temperatures
- Increase exposure time to direct sun, ambient temperatures, and wind in stages by moving seedling trays outside and then back into the protected growing area.



### Transplanting

- Transplant on cloudy days to minimize sun burn.
- Water well after transplanting.
- Plant at the same depth as in the pot.
  - Exception, tomatoes, sometimes



### Plant Growth rates

- Generally, up to a maximum, the higher the temperature, the faster the plant will grow. An 18 degree increase doubles the growth rate (assuming light and moisture are sufficient). **This is crop/variety dependent!**
- The **size of the plant** will affect the growth rate
- So will the spacing and weed competition
- **It's all about leaf area and light collection and heat!**



### More detail on seedling growth rates

- If growth rate of a **10 gm transplant** is .1 gram/gm of plant weight per day, it will weigh **19.5 gms** after a week, an increase of **9.5 gms**
- A **30 gm transplant** is growing at the same growth rate, will weigh **58.5 grams** after a week an increase of **28.5** grams.
- Adding **18° F more heat** to the original **10gm** transplant will almost double the original growth rate to **35.8 gms** after a week

### Season Extension: Coldframes

- Miniature greenhouse
- Can add up to 45 days to growing season.
- Typically 3' wide by 6' long; 18" high in back & 12" high in front.
- Faces south or west with glass or plastic top at a 30-45° angle.
- Open top on sunny days.



Cloches: Must be able to open up on sunny days.



### More cloches



### Season Extension: Floating Row Covers

- Frost protection
- Warmer microclimate
- Wind protection
- Excludes insect and bird pests
- Reduced evapotranspiration
- Good for beans, beets, carrot, cole crops, corn, lettuce, parsley, peas before a trellis, potato, radish, scallions, and spinach



### Row covers

- Lightweight fabrics: do not need frames. Leave slack.
- Improve day temperatures ~ 6-8 degrees
- Improve night temperatures ~ 3-4 degrees
- Can encourage slugs and weeds
- Used widely in commercial vegetable growing



### Row covers



### Season Extension: Individual Plant Covers

- Hotcaps
- Wall-o-Water
  - Plastic baffled chambers filled with water.
  - Will protect plants down to the teens.





Hoop house and milk jugs as hot caps. Can also use row covers inside a hoop house for more extreme cold periods.

## How soil affects vegetable quality

- Soil fertility (nutrient deficiency)
- Drainage for aeration, tillage characteristics and heat
- Watering cycle (how often and how much)
- Specific crop performance for some vegetables (like carrots)



## Direct Seeding

- Planting time dependent on soil temperatures, pests, and need.
- Plant seed as deep as the seed is wide.
- Seed info will tell you how far to space the seed.
- Keep seed moist until plants germinate.
- Soil crusting!!



## Direct seeding issues

- Temperature:
  - Temperature optimums plant specific – too high and they will go “thermo-dormant” and won’t germinate even if soils cool down for some time. With some lettuce varieties, soil temps above 77° will cause this. Temps too low and certain seeds are very slow to emerge and can lost to disease and/or insect attack.
  - Minimum temperatures are not optimum temperatures (repeat three times)!



### Soil crusting

- Problem on high clay/silt soils
- Tillage followed by seeding followed by rain or irrigation followed by sun can leave an adobe layer on the surface. **Hard for some seeds to break through.**
- Cover seeds with a potting mix and/or use row covers. Drip irrigation reduces problems.
- Carrots, beets, lettuce very susceptible. Poor stand.



### What can you change?

- Minerals (fairly easily with fertilizers)
- Drainage (a big and expensive project if using drain tile). Raised beds as an alternative.
- Tilt (moderately easy with compost, cover crops and time). Important on clay soils.
- Work soils down to 6-7 inches.
- Remove large stones, clods, or plant debris. Particularly important with root crops.



Compost is good for soils!



### Compost

- Benefits:
  - Improves water retention
  - Promotes soil structure
  - Increases fertility
  - Increases cation exchange
  - Reduces fertilizer requirements up to 50% except N
  - Enhanced microbial activity
    - Suppresses pathogens
    - Accelerates the breakdown of pesticides & other synthetic compounds





### First tilling in the spring

- Soil must not be too wet (how do you know?)
- Why?
- Hand spading vs. roto-tilling
- How deep?



### How big an area to rototill?

- Aren't roto-tillers fun?!!!



Consequences  
of irrational  
exuberance

### For beginners, small is good



Time it takes  
to maintain a  
garden after  
planting = ~  
60 minutes a  
week for a 10'  
X 10' garden.  
How much  
more time for  
a 30' X 30'  
plot?

### What do you do with grass and weeds in a new garden area?

- Cover the area in the winter or early spring with black plastic or
- Dig the sod out or
- Herbicide treatment or
- Roto-till them in







### "Lasagne" gardening

Timing to control grass/weeds

Soil amendment options

Need raised bed frame?



"Lasagne" gardening

### Why raised beds?

- Compact growing area (better use of fertilizers)
- Soil drains and warms faster (warm soils are a big deal in Western Oregon!)



### Disadvantages of raised beds

- May require more water in the summer
- Higher maintenance
- More hand work (weeding and cultivating prior to planting)
- Slugs (maybe)



### Materials for sides

- Raw wood
- Pressure treated wood
- Plastic composite ("Trex" et al)
- Molded plastic
- Stone or concrete blocks
- Other?



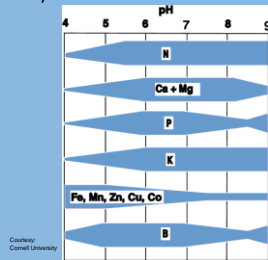
### Fertilizer basics

- Soil test?
- pH is important - most vegetables prefer a pH of 6.5-7.0
- Lime corrects low pH
- Liming rate: 80-150 #s of lime per 1000 square feet once every three years.
- If low magnesium, use dolomite lime?
- Wood ashes? How much?



## Soil pH and mineral availability

- As pH rises, some key mineral availability increases
- Aluminum (tracks with manganese (Mn)) decreases as pH rises. It is somewhat plant toxic, so this is a good thing.
- Liming provides Ca and Mg if using dolomite



## Fertilizer basics

How is fertilizer applied?

- ❖ Broadcast and tilled in
- ❖ Banded below and adjacent to seed
- ❖ Side-dressed
- ❖ Liquid or foliar



See a difference?



Nitrogen disappears = N deficiency = poor crop performance

- New fields have some residual N
- Tillage opens the field to rapid N loss (very water soluble)
- Cover crops can capture N but don't release the N early in the gardening year
- Organic matter and N



Nitrogen: 100#s/ac on left, zero pounds on the right



How much to apply?

- Vegetable gardens will need about four pounds of actual N per 1000 square feet.
- Calculate from this example:  
 $4/.28 = \sim 14$  pounds of the fertilizer per 1000 square feet



### Decisions that influence food safety

- Food safety issue: Deer and rodents in addition to livestock manure
- Greater problem with root crops and leafy greens
- Compromised irrigation water
- Timing of manure application: National Organic Standards: 90 days pre-harvest if crop not touching, soil 120 days if it is.



Photo: Kurreal Far North

## Is compost fertilizer?

- Yes and No
  - What happens in the composting process?
  - What is the value of compost?
  - How can you get in trouble with compost?



## Soil organic matter improvement

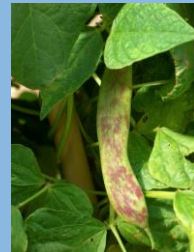
- Why?
  - Improved winter drainage
  - Better water-holding in summer
  - **Fix and/or capture nitrogen**
  - Improve tilth
- Legumes, grains, and other plants
- Summer and winter cover crops
- Management issues
  - Tillage complications
  - **Temporary N tie-up**
  - Some crops may increase disease and/or insect pressure for your crops



Heavy Feeders		Light Feeders	
Asparagus	Lettuce	Carrot	Alfalfa
Beet	Okra	Garlic	Beans
Broccoli	Parsley	Leek	Clover
Brussels sprouts	Pepper	Mustard Greens	Peas
Cabbage	Potato	Onion	
Cantaloupe	Pumpkin	Parsnip	
Cauliflower	Radish	Rutabaga	
Celery	Rhubarb	Shallot	
Collard	Spinach	Sweet Potato	
Corn, Sweet	Squash, Summer	Swiss Chard	
Eggplant	Strawberry		
Endive	Sunflower		
Kale	Tomato		
Kohlrabi	Watermelon		

## Other minerals

- Phosphorus (P)
- Potassium (K)
- Magnesium (Mg)
- Sulfur (S)
- Calcium (Ca)
- Micronutrients



What does the family like to eat?

- Greens?
- Corn?
- Squash?
- Onions?
- Rutabagas?
- Radishes?
- Grow what they like and then experiment



Starter vegetables



- Transplants or seeds?
- Less fuss vegetables  
Greens, tomatoes, peppers (once it is warm) onions, garlic, summer squash, corn, beans, etc.

### Children's vegetable gardens

Best bets: carrots, cherry tomatoes, potatoes, strawberries, radishes, peas ..... This is a garden area to graze in.



### The cost-effective garden

- Grow what will be eaten fresh and/or preserved for later. This is an art.
- Grow vegetables that you would otherwise buy.
- Grow vegetables that make good use of space
  - Examples: Green onions, all leafy greens, herbs, green beans, garlic, bulb onions, cucumbers etc.



## Variety Selection Considerations

- Size of Mature Plant
- Days to Harvest
- Heirlooms
- Disease Resistance
- Saving Seed



## Succession Planting



- Planting late-season crops after early season ones have been harvested – peas followed by beans.
- Multiple plantings of a single crop.
- Planting different cultivars with different maturity dates – cabbage & corn.

### Early Season Crops

Early Beets  
Early Cabbage  
Lettuce  
Onions  
Peas  
Radishes  
Early Spinach  
Mustard  
Turnips  
Kale  
Carrots  
Parsnips  
Cilantro  
Parsley

### Long Season Crops

Beans  
Cabbage  
Celery  
Sweet Corn  
Cucumbers  
Eggplant  
Muskmelons  
Peppers  
Potatoes  
Pumpkin  
Squash  
Swiss Chard  
Tomatoes  
Watermelon

### Late Season Crops

Bush Beans  
Beets  
Broccoli  
Chinese Cabbage  
Carrots  
Cauliflower  
Endive  
Kale  
Kohlrabi  
Lettuce  
Radishes  
Spinach  
Turnips

## Sun/shade relationships





### More trellis ideas



### Why Rotate Crops?

- Insect & disease management:  
Rotate area to different plant family
- Weed management
- Nutrient demands
  - Increased soil nitrogen
- Benefits of the preceding crops
  - Improved physical condition of the soil
  - Increased microbial activity
  - Increased release of CO<sub>2</sub>
  - Excretion of beneficial substances



### Crop Rotation: Families Matter

- Potatoes, tomatoes, peppers, and eggplant are all members of the solanaceous family.
- Beans and peas are legumes.
- Cucumbers, melons, pumpkins, and squash are all cucurbits.
- Radishes, rutabagas, and turnips are all cole crops just like cabbage, broccoli, cauliflower, and Brussels sprouts.
- Onions, garlic, leeks, shallots, chives are alliums.
- Crop rotations of at least 4 years are recommended.

### Irrigation

- 1 " water per week minimum from June to September
  - 1 " over 100 square feet = 65 gallons
- 2+ inches/week may be needed for hot weather
- Deep watering 1-2 x per week for established plants
- Seedbeds, seedlings need daily care

### Irrigation Methods

- Water soil, not plants
- Hand
- Oscillator
- Other sprinklers
- Soaker hose
- Drip
- Compost and mulch!



### Mulching

- Organic – breaks down
  - Straw
  - Chopped leaves
  - Wood chips
  - Grass clippings
- Inorganic
  - Plastic
- Benefits
  - Weed suppression
  - Temperature moderation
  - Soil moisture moderation
  - Sanitation
  - Add nutrients



### Harvest

- Timing
  - Harvest early in the day
  - Know maturity stage
- Prevent wounds at harvest
- Cool the vegetables quickly & thoroughly – tomatoes and a few others are exceptions



### Cover Crops and Green Manures

- Rests soil
- Cover Crops
  - Crop grown to protect/enrich soil
- Green Manure
  - Crop incorporated into soil
- Build soil overtime
  - Structure
  - Fertility
- Fava beans, vetch, oats
- Buckwheat, daikon radish



### Clean-up and Rotation

- Clean beds after crops
- Compost disease-free material
- Add 2" + compost and fertilizer as needed
- Rotate crops
  - Avoid accumulation of disease vectors by rotating plant families
  - Heavy feeders, soil builders
- Cover soil in winter

### Winter gardening

- Plants are started in July and August
- They survive winter temperatures
- Mostly greens, leeks, garlic
- Kale is a wonder plant!
- Plastic cloches or hoop houses help



### Alliums

- Fall planted: Over-wintering onions in August. Shallots and garlic in the fall.
- Spring planted: Bulb onions, green onions, some shallots, leeks in June/July for winter harvest.



## Garlic

- Many varieties: Soft neck and hard neck
- Planted from cloves in the fall on beds
- Lime, fertilize pre-planting and light compost mulch after planting
- Usually doesn't emerge until January
- Weed throughout the winter
- Fertilize several times in the spring
- Slugs
- Harvest in mid-July



## Bulb onions

- Direct seeded or transplanted starts/sets
- Very poor competitors against weeds – early weeding crucial, especially with direct seeding
- Long day onions for this latitude
- Can handle frosts
- Need good, fertile soil (check fertilizer guides for details)
- Watering crucial when bulbing
- Storage qualities vary considerably among cultivars



Total Seasonal Evapotranspiration [in]	25.4 (mean)
Peak Evapotranspiration Rate [in/day]	0.25
Maximum Allowable Depletion [percent]	30
Critical Moisture Deficit Period	Bulbing, bulb expansion

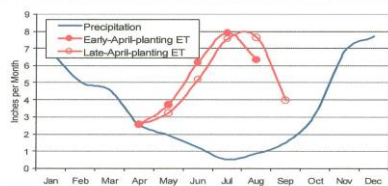


Figure 1: Typical precipitation and bulb onion evapotranspiration (ET) in the Willamette Valley. Tabulated values of ET are provided on the back of this sheet.

## Fusarium basal plate rot

- Seed borne
- Worse in wet springs
- > problem
- Sanitation and rotation



### Garlic rust

- > problem since early 2000
- Fungal disease spread in wind and from infected plant debris
- Worse in rainy springs
- Huge issue now in W. Oregon
- Few controls except debris management and rotation for the organic grower



### Botrytis or gray mold

- Clove borne
- > by wet springs
- Storage disease
- Air circulation critical
- Good planting stock
- Irregular black sclerotia stay in soil for some years.
- Sanitation/rotation



### White rot

- Affects most alliums
- Worst disease
- Long soil life (10+ years)
- Moves on plants and/or cloves
- No treatments



13.42c White rot sclerotia of *Sclerotium cepivorum*

### Broccoli and associated crops

- Cold hardy (varies)
- Generally transplanted
- Spacing of 8-10" within the row and 12-14" between rows
- Lime well to reduce club root
- Follow fertilizer guide and soil test results
- Maintain uniform soil moisture
- Plow down before fall rains to reduce blackleg.





### Boron issues in cole crops

- A nutrient needed in very small quantities
- Symptoms & quality loss in broccoli, cauliflower, and other crops
- Hollow stems and poor heads
- Carefully calibrate boron applications to soil or as a foliar spray
- Some varietal resistance



### Club root of crucifers

- Long rotations
- > pH with lime
- Some resistance
- Grow in the best possible manner to outgrow the problem





### Cabbage flea beetles

- More a spring problem
- Serious on transplants and seedlings
- Some insecticide options
- Row covers early



Flea beetle damage

### Aphids and whiteflies

- Pierce & suck sugars
- High reproductive rate
- Overwinter or blow in
- Row covers?
- Insecticides
- Predators
- Not consumer friendly



### Imported cabbage butterfly

- Common
- Caterpillar feeding damage
- Insecticides (inc. Bt)
- Row covers







### Cabbage root maggot (fly)

- Very serious pest – several cycles
- Worst on cabbage family root crops (turnips, rutabagas, radishes) and cauliflower/broccoli
- Few useful insecticides
- Row covers
- Rotations and winter residue management



8.41a Cabbage root maggot: adult flies.  
Cabbage maggot adults and larvae



8.41d Cabbage maggot; eggs at base of stem.



*Hylemya brassicae* (Bouché)



### Lettuce and mixed greens

- Major crop of small farms
- Many new varieties and species
- Mostly transplanted
- High labor requirement
- Maintain uniform moisture
- Whole head and cut leaf production
- Suitable for winter (protected) production



### Lettuce problems

- Slugs
- Damping off
- Calcium deficiency (tip burn)
- Downy mildew
- Anthracnose
- Soft rot in storage
- Ethylene reactions (russet spotting)
- Improper harvest and storage





Slugs of several types

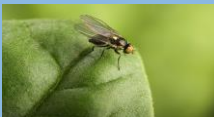
### Beets, spinach and chard

- Crusting (poor emergence)
- Thinning
- Boron deficiency on beets
- Beet/chard/spinach leaf miner
- Spinach timing re bolting to seed



### Beet or chard or spinach leafminer

- Fly maggot that "mines" the leaf
- Row covers
- Insecticides
- Timing of planting
- Sanitation



### Carrots and Parsnips

- Crusting (poor stand emergence)
- Thinning
- Uneven watering effect
- Poor soil for normal carrot growth
- Carrot rust fly



### Thinning carrots

- Depends a bit on row spacing
- Timing is important
- Leaf area development and photosynthesis

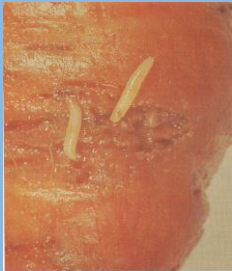


### Misshapen carrots

- Rocky or heavy clay soil
- Too much nitrogen
- Genetics
- Uneven watering



Carrot rust fly damage



6.23a Carrot rust fly; larvae and feeding injury on a carrot root.

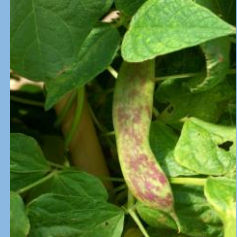
### Carrot rust fly larvae

Best managed with row covers to prevent egg laying

Some insecticides available

### Peas and beans

- Direct seeded
- Poor emergence (soils too cool)
- Bush and pole varieties
- Pea vine weevil
- Pea enation virus
- Gray mold on beans



### Pole beans

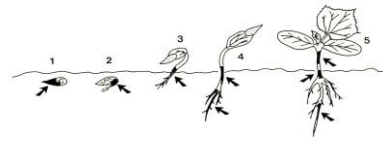


### Bush beans





More trellis ideas



Root infection at emergence



Fusarium root rot



Gray mold (Botrytis) and white mold (Sclerotinia)



Pea leaf weevil



Pea enation mosaic virus

### Sweet corn

- Generally direct seeded but can be transplanted
- Poor emergence
- Thinning/spacing
- Nitrogen deficient
- Poor pollination
- Several insects







Corn earworm

### Potatoes

- Variety selection (costs/returns)
- Uniform watering
- Hilling to prevent greening
- Hollow heart
- Various diseases



Potato: Hollow heart. Calcium deficiency



Common scab



Rhizoctonia blight "scurf"



Bacterial ring rot



Tuber flea beetle



Symphylans and damage



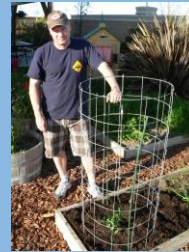
## Tomatoes and peppers

- A warm tomato is a happy tomato
- Excellent market for specialized varieties
- Start 40-50 days before transplanting
- Season extension techniques key
- Even moisture very important
- Trellis tomatoes and possibly stake peppers
- Lime and fertilize according to test



## Tomato supports

- Cages
- Livestock panels
- Woven support
- Single stake



### More tomato support



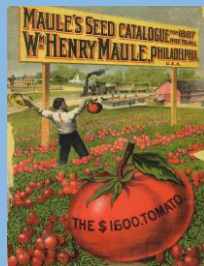
### Single stake technique

- More pruning
- Closer together
- High Maintenance
- Higher yield per square foot



### Tomato and pepper problems

- Early and late blight
- Blossom end rot
- Cracking
- Cat facing
- Sunburn (peppers)
- Miscellaneous storage rots
- Aphids



Sunburn on peppers





Blossom end rot

Blossom end rot (not a rot but a calcium disorder):

- Lime
- Even watering
- Some shoot removal
- Variety selection



Cat facing: weather related







Tomato pollination problem - weather related



Late blight



Late blight  
Copper before infection  
Little resistance



Herbicide injury

185

### Cucumber growing

- Need heat - not frost hardy
- Often transplanted. Spacing 8-12" within rows with rows 48-72 inches apart.
- Often grown with plastic mulch and drip irrigation. Row cover early.
- Needs about 100 to 150 actual pounds of N per acre. Other fertilizer as per test.
- Can be trellised.
- Slicers vs pickling cukes





## Winter and summer squash

- Very productive in our region
- Winter squash take a lot of space
- Fairly high nutritional and water demand
- Storage potential for winter squash



## Cucurbit problems

- Powdery mildew
- Angular leaf spot
- Storage diseases
- Several virus diseases
- Buy disease resistance in seed lines when available
- Cucumber beetle
- Pollination failures
- Bitterness
- N and/or Ca deficiency



## Bitter cucumbers (and sometimes zucchini)

- Genetic component
- Response to stress
  - Too cold
  - Too hot
  - Too much water
  - Too little water
  - Disease



A few comments on cucumber beetles, of which we have the Western Striped Cucumber beetle



...and the Western Spotted Cucumber beetle



...or both together



#### *Powdery mildew* management:

- Scout older crown leaves
- Apply fungicides when indicated
- Select resistant varieties where possible



*Angular leaf spot* bacterium over winters on diseased plant material or on seed. Symptoms on fruit smaller than on leaves. May be an entry point for other soft rot organisms.

#### Control:

- Rotation
- Sanitation
- Resistance
- Copper products
- Seed treatment



## Cucumbers

- Standard cucumbers are monoecious (i.e. male and female flowers on the same plant). These need pollinator insects.
- Parthenocarpic cucumbers set fruit without pollination. Usually used for greenhouse production.
- Gynoecious cucumbers are “predominately female” (PF) flowered with a few males in the mix of seeds.

Trellis panels for cucumbers are tied to T-posts

Plastic mulch

