

Growing new vegetable gardeners



Why 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



Other motivations for vegetable gardening

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



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?

Questions to answer before you begin:

- Who 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

Core concepts

- Right plant, right place (and time)
- Soil tilth & bed preparation
- Early heat is good (greenhouse and/or row covers)
- Soil fertility and proper irrigation matters
- So does plant spacing
- Weeds, insects, and diseases can be devastating
- Grow it well and harvest it right



For vegetables, climate matters



Frost and heat

- Do zones matter?
- Will the vegetable mature?
- Do you want a winter garden?
- So describe our climate

Frost intervals

St Helens 32°F 4/20 (Spring) 10/31(Fall)

Vernonia 32°F 5/15 (Spring) 10/05 (Fall)

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!!

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.

When you're hot, you're hot

- July averages

Albany NY	71.1	Chicago day: 83.5°
Chicago	73.3	“ night: 63.2°
Des Moines	76.1	Average: 73.3°
Portland	68.7	Portland day: 80.2°
Seattle	65.3	“ night: 57.2°
		Average: 68.7°

Growing degree days

• Astoria	1438
• Seaside	1492
• Tillamook	1279
• Cloverdale	1511
• Vernonia	~2050
• Kelso	2004
• Portland	2586



GDD = High temp+low temp/2 -50
 Example: 58 + 50 = 108/2 = 54-50 = 4 GDD

Average Annual Precipitation Oregon

Legend (in inches)

Under 20	100 to 120
20 to 40	120 to 140
40 to 60	140 to 160
60 to 80	160 to 180
80 to 100	Above 180

Period: 1961-1990



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!

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.

It's also about location and sunlight!!

≥6 hours

- Access for ease of working and peer pressure to get it right



Access

- Near the house.
 - Easy to get to when harvesting.
 - Accessible for weeding, cultivating, & staking plants.
- Close to water.
- May deter deer (or not).



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)

What can you change?

- Minerals (fairly easily with fertilizers)
- Drainage (a big and expensive project if using drain tile). Raised beds as an alternative.
- Irrigation timing and amounts (complex)
- Tillage (moderately easy with cover crops and time)

Physical Requirements: Soil

- Well-drained.
- Solutions for clay soils:
 - Add organic matter
 - Raised beds
- Work soils down to 6-7 inches.
- Remove large stones, clods, or plant debris. Particularly important with root crops.

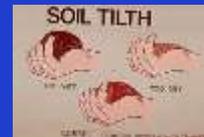


Compost is good for soils!



First tilling in the spring

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



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

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



"Lasagne" gardening



"Lasagne" gardening

Timing to control grass/weeds

Soil amendment options

Need raised bed frame?

How big?

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



Consequences of irrational exuberance

For beginners, small is good



Physical Requirements: Compost



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

Physical Requirements: Temperature

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



Vegetable gardening styles

- Rows
- Beds/intensive
- Jumbled/mixed
- Container gardening

All have to take drainage into account



Why beds?

- Compact growing area (better use of fertilizers)
- Soil drains and warms faster (warm soils are a big deal in Western Oregon!) if beds are raised – not so much of an issue on better drained soils.



Why raised beds?



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?





Container Vegetable Gardening

- Medium
 - Structure (1 loam : 1 Peat/Compost : 1 Sand)
 - Fertility (well balanced 10-10-10)
 - Compost, seed meals
- Drainage
- Materials
- Watering
- Varieties
- Herbs



Fertilizer basics (1)

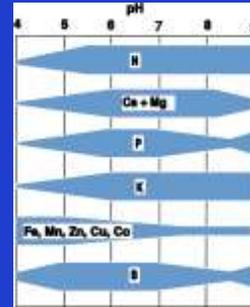
How is fertilizer applied?

- ❖ Broadcast
- ❖ Banded
- ❖ Side-dressed
- ❖ Liquid or foliar



Fertilizer basics (2)

- 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.
- Why dolomite?
- Wood ashes? How much?



Fertilizer basics (3)

- Nitrogen is very important!! Why?
- There are both organic and conventional nitrogen sources
- N deficiencies can be corrected if caught early



Nitrogen disappears = N deficiency = poor crop performance

- New garden areas have some residual N
- Tillage opens the soil 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

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?



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





Nitrogen fertilizer experiment

LSU (courtesy, Dr. Brenda Tubana)

How much to apply?

- Vegetable gardens will need about four pounds of actual N per 1000 square feet.
- Calculate from this example.



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



Source: Getty Images/Getty Images

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

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



Planting

- Timing
- Sun and shade tolerance
- Direct seeding
- Transplants
- Starting seeds
- Spacing & thinning
- Sequential planting
- Crop rotation



Timing

- Soil temperature
 - Cool-season crops = 40° minimum but prefer much warmer
 - Warm-season crops = 50-60°
- Raising soil temperatures prior to planting - uses of clear plastic
- Avoidance of pest problems
 - Cole crops – cabbage maggot, flea beetles
 - Seed corn maggots

Sun/shade relationships



More trellis ideas



Direct Seeding

- Plant seed as deep as the seed is wide.
- Seed packets will tell you how far to space the seed.
- Keep seed moist until plants germinate.
- Lettuce seed requires light to germinate.
- Soil crusting!!



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.

Spacing & Thinning

- Space seeds as recommended on the packet.
 - Dense planting will promote disease.
- Many crops will need thinning (whoever gets the light, wins!):
 - Carrots
 - Radishes
 - Beets
 - Lettuce
 - Corn !!



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
Onion Sets
Peas
Radishes
Early Spinach
Mustard
Turnips

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

Why Rotate Crops?

- Insect & disease management
- Weed management
- Nutrient demands
 - Increased soil nitrogen
- Benefits of the preceding crops
 - Improved physical condition of the soil
 - Increased microbial activity
 - Increased release of CO₂
 - Excretion of beneficial substances

Crop Rotation

- 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.

Don't forget that you planted a garden



Weed management

- Plan for weeds
- Options:
 - Hand weeding or tilling
 - Mulching
 - Transplanting
 - Intensive planting
 - Spot herbicide treatment



More on weeds

Weeds do most of their damage when seedlings are small

The most important time to watch for weeds is the 3-4 weeks after planting your seeds



Weeding matters (esp. early!)

	Unweeded	Weeded
Carrots	28 lbs	503 lbs
Onions	3.6 lbs	68 lbs
Cabbage	129 lbs	233 lbs
Potatoes	53 lbs	148 lbs

Adding heat to your vegetables

- Transplants (also help with weeding)
- Raised beds
- Cloches
- Floating row covers
- Walls of water and hot caps

Transplants

- I love transplants!
- Why?



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.



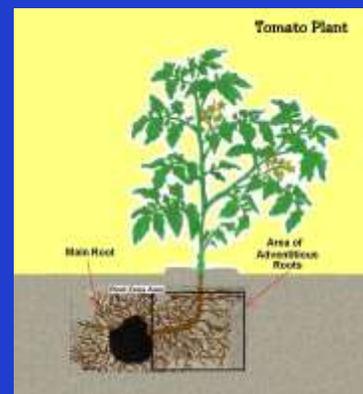
Hardening Off

- 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 scald.
- Water well after transplanting.
- Plant at the same depth as in the pot.
 - Exception, tomatoes



Clear plastic mulch: warms soil more than black plastic



More 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 with 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.



Watering

- Match water application to plant needs.
- Based on
 - Soil type
 - Rainfall
 - Crop requirements
 - Growth stage
- Experience and soil examination are best measures.
- Rain gauge
- Don't base watering on crop appearance.



Irrigation

- 1 " water per week minimum from June to September
 - 1 " over 100 ft² = 65 gallons
- More 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
- Discard culls
- Cool the vegetables quickly & thoroughly
- Quality is reduced by
 - Improper temperature
 - Drying
 - Mechanical injury
 - Disease
- Respiration leads to
 - Drying out
 - Reduced food value
 - Less sweetness (CHO broken down)
 - Less dry weight



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, diakon



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



Specific vegetable production issues



Deer

- Damage crop
- Contaminate crop
- Fencing
- Washing of crop (not always feasible e.g strawberries)



Slugs/snails of several types



Caffeine study of feeding aversion and snail toxicity at various caffeine concentrations

Slug/snail management

- Relentless attention
- Debris/mulch management
- Sharp hoe
- Baits (iron phosphate types like Sluggo)



Symphylans: Very small. Root feeders. Roto-tiller management. Patchy damage in field. Fairly wide host range. Potato bait test. Depletion crops like buckwheat.

Abiotic (non-living) problems:

Weather (frost, hail, sunburn, water stress)
 Herbicide injury
 Reaction to protectant chemicals
 Mechanical injury
 Root environment
 (esp. poor drainage)
 Mineral deficiency
 or toxicity



Herbicide drift injury

- Mostly the phenoxy herbicides
- High volatility under some conditions and formulations
- Characteristic cupping injury



Bitter cucumbers (and sometimes zucchini)

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



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

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



...and the Western Spotted Cucumber beetle



...or both together



The Western Spotted Cucumber beetle has a huge plant host range whereas the Western Striped Cucumber Beetle is much more focused on cucurbits.

Damage can include stem and root feeding (especially hard on young plants), foliage feeding and blossom and pollen feeding.



Cucumber beetles also transmit bacterial wilt and cucumber mosaic virus. Other diseases may also be moved by their feeding.



Cucumber beetle control:

Biological: tachinid flies, nematodes

Cultural: row covers

Chemical (organic): pyrethrum (Pyganic) and spinosad (Entrust)

New approach: Combining attractants with an insecticide (no organic products yet).

Kairomones.



Powdery mildew

Powdery mildew management:

Scout older crown leaves

Apply fungicides when indicated

Select resistant varieties where possible





Angular leaf spot

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



Scab (gummosis)

Fungus over winters in debris. Spread by rain, wind, insects and tillage. Spots numerous and turn from pale green to white. Leaf cracks. Infected fruit shows oozy drops. Spots decay further into flesh.



Control:

Rotation
Plow down debris
Appropriate fungicide

Storage rots



Alliums

- Fall planted: garlic, overwintering onions in August, shallots, leeks in June/July for winter harvest.
- Spring planted: Bulb onions, green onions, some shallots



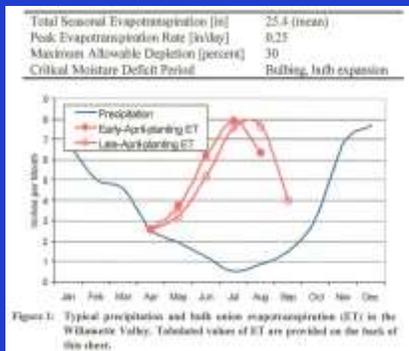
Garlic

- 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 weed competitors— early weeding crucial, especially with direct seeding
- Long day onions for this latitude
- Can handle frosts
- Need good, fertile soil
- Once bulbing starts, a water shortage will stop the process and it is difficult to get them bulbing again.



Onions continued

- Harvested late September when tops start to fall
- Usually cured with their tops on, in the field or in a barn on racks with good air circulation. Tops removed later.
- Storage qualities vary considerably among cultivars – know your market!



Leeks

- Direct seeded or transplanted in late spring through the end of June
- Very winter hardy and can stay in field for harvest over time
- Fair amount of cleanup work with leeks
- Modest market demand, though increasing
- Whole plant is sold minus some root and top trimming



Allium problems

- Botrytis (fungus)
- Fusarium (fungus)
- White rot (fungus)
- Rust (fungus)
- Poor irrigation (esp. at bulbing)
- Thrips
- Onion maggot (rarely)
- Weed suppression



Onion thrips damage: More serious on water-stressed plants

Onion thrips



- Thrips pierce plant cells and suck juice causing silverying
- Worse in dry warm weather
- Grow away from cereal or grass if possible
- Biocontrol w/ minute pirate bugs

- Overhead irrigation
- Bury culls in fall and alternative hosts in spring
- Thresholds increase as bulbs develop (3-10/plant during early bulb dev.)
- Glossy varieties ('Superstar', IPA-3)
- Sunflowers enhance pirate bugs
- Entrust (Spinosad)



Fusarium basal plate rot

- Seed (clove) 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



Potatoes

- Variety selection
- Uniform watering
- Hilling to prevent greening
- Hollow heart
- Various diseases and insects



Hollow heart. A low calcium disorder in which variety selection, uniform watering, spacing, and calcium in soil play a role.



Common scab: A fungus best managed by variety selection, lower pH, rotation and sulfur dust at planting.



Rhizoctonia blight "scurf"

Potato late blight

- Predisposing factors:
 - Rain
 - Night time overhead irrigation
 - Inoculum residue
 - Variety
 - Poor air circulation
- Infects both foliage and tubers. Copper fungicide pre-rain.

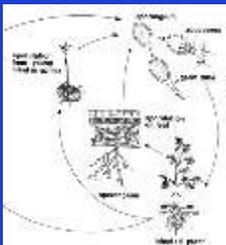


Potato late blight



Late Blight Disease Cycle

Causal agent: *Phytophthora infestans* (Oomycete, related to algae)



Can only survive on living host tissue - so destruction of diseased tubers is best management strategy

Many spore cycles; can move with wind and rain

Sporangia may be dispersed to neighboring fields, but do not generally survive long-distance travel because of desiccation and exposure to solar radiation.

Rotation in time and space during single season....and excellent cultural practices

<http://www.apsnet.org/education/LessonsPlantPath/LateBlt/CYCLE.HTM>



Bacterial ring rot: Certified seed and rotation.



Tuber flea beetle: Larval feeding sometimes looks like scab. Rotation. Monitor. Spinosad treatment of adults early.

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





Total Seasonal Evapotranspiration (in)	13.9 (mean)
Peak Evapotranspiration Rate (in/day)	0.27
Maximum Allowable Depletion (percent)	30
Critical Moisture Deficit Period	Head development

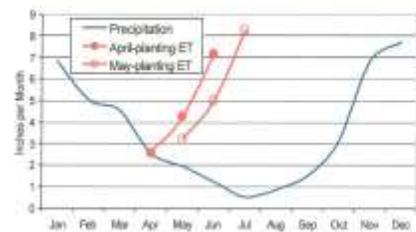


Figure 1: Typical precipitation and monthly evapotranspiration (ET) in the Willamette Valley. Tabulated values of ET are provided on the back of this sheet.

Broccoli etc. problems

- Imported cabbage butterfly
- Cabbage root maggot
- Cabbage aphids
- Cabbage flea beetles
- Club root
- Poor heads due to late harvest
- Poorly cooled after harvest

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 > Too much is a soil sterilant
- Some varietal resistance



Club Root of Crucifers



Club root of brassicas: Not all types equally susceptible but all can sustain. Rotation. Regular liming and hydrated lime just before planting.



Flea beetle damage

Brassicas: Flea beetles



- Severe in hot, dry weather
- Young plants susceptible, after 6-8 leaves plants compensate for damage
- Larvae may damage root brassicas
- 75 beetles/plant can damage mature cabbage
- Waxy leaved varieties more tolerant



Brassica flea beetles

- Timing of seeding to avoid hot weather for small, susceptible plants
- Row covers
- Move leafy brassicas to avoid damage (300+ft) – jumping rotation
- Organic mulch and trap crops
- Predatory nematodes, Pyganic, Entrust (spinosad), neem
- Other insecticides?

Aphids and whiteflies

- Pierce & suck sugars
- High reproductive rate
- Overwinter or blow in
- Row covers?
- Insecticides- soaps and others
- Predators
- Not consumer friendly
Cleanup before sale?





Cabbage root maggot fly: Fly lays eggs on stem or base of plant. Maggots emerge and go underground to eat roots. Damage can be minor or serious.

Row covers, rotation, resistance, avoidance planting. Spinosad(?) with timing issues.



Cabbage maggot adults and larvae



Cabbage maggot eggs at base of stem



Imported cabbage butterfly



Imported cabbage butterfly larvae



Cabbage butterfly larva

Cabbage butterfly

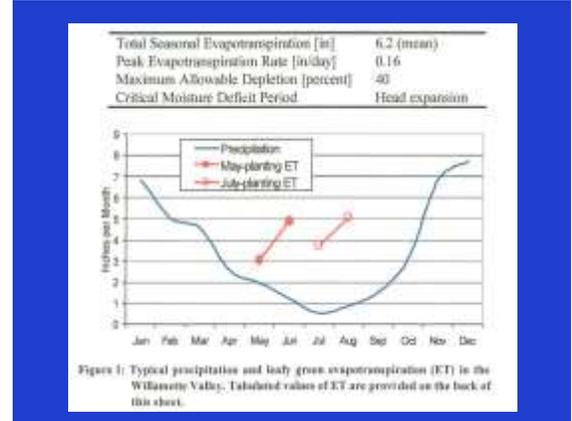
- Manage with
 - Row covers
 - BTK (a bacterial insecticide)
 - Spinosad
 - Pyganic
 - Yellowjackets ?



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
- Highly 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

Beets, spinach and chard

- Crusting
- Thinning
- Boron deficiency
on beets
- Beet/chard/spinach
leaf miner
- Spinach timing



Beet or chard or spinach leafminer

Beet etc. leaf miner

- Row covers
- Spinosad
- Pyganic
- Still good to eat, just not to sell



Carrots

- Crusting
- Thinning
- Uneven watering effect
- Poor soil for normal carrot growth
- Carrot rust fly



Thinning carrots

- Depends a bit on row spacing
- Timing is important: earlier is best



Misshapen carrots

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



Carrot rust fly



- *Psila rosae* feeds on Umbelliferae
- Red eyes, orange head, shiny black body with yellowish legs,
- Overwinter as larvae in roots
- Spring adults active mid-April to mid-June
- Larvae present June to mid-July
- Summer adults active mid-July to early September
- Larvae present mid-August to late September
- Fall adults active late September to mid-October
- Larvae enter roots from early October and overwinter.

Carrot rust fly



www.bbc.co.uk



<http://www.inra.fr/hyppz/>

- Rotation can help – ¼ mi jumps?
- Delayed planting and early harvest to avoid populations.
- Floating row covers from mid-April or emergence.
- Clean harvest leaving few roots in field.
- Deep ploughing in fall or spring can help
- Nantes types more resistant, Danvers types more susceptible.
- Spinosad, pyganic



A.22a Carrot rust fly, larvae and feeding tunnels on a carrot root.

Carrot rust fly larvae

Best managed with row covers to prevent egg laying



Peas and beans

- Direct seeded
- Poor emergence
- Bush and pole varieties
- Pea vine weevil
- Pea enation virus
- Gray mold on beans

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



Seed corn maggot



Corn earworm

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



Tomatoes in high tunnel



Tomato and pepper problems

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



Sunburn on peppers





Blossom end rot



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



Cat facing: weather related



Tomato pollination problem - weather related



Late blight



Late blight



Herbicide injury

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