




1

NOTE

- Pesticides listed in this presentation examples from the PNW Handbook, more options can be found there for specific pests.
- OSU Does not endorse one pesticide, or brand name over another.
- **ALWAYS read the label on ANY pesticide before application**
- **ALWAYS follow label requirements when using pesticides**



2

Start with the basics

- Inventory your land: What resources do you have?
- How much space do you want to contribute?
- Think horizontally *and* vertically
- Trees and vines can grow large
- Soil profiles are important

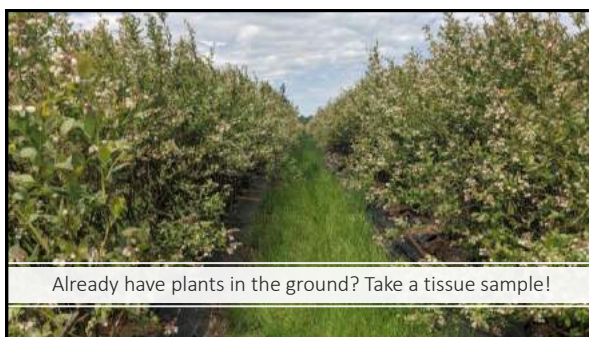
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Take a soil sample!

- SOIL! Is very important when growing permanent crops
- It's easier to amend before you plant
- What is your soil texture profile?
- What's the pH?



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About Blueberries

- *Vaccinium corymbosum* (Northern Highbush)
- *Vaccinium virgatum* (Rabbit Eye)
- Long lived-perennial
- Fibrous, shallow root systems
- Native species to North America



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Blueberry root systems

- Shallow
- Fibrous
- Sensitive to fertilizers, soil type and drainage



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Site selection



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Site selection

- Sunny
- Avoid planting in areas surrounded by trees
- Avoid wet areas



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Site selection

- Well drained soil
- High OM
- Loamy Soil preferred
- Low pH (4.5-5.5 Northern highbush, 4.2-5.2 Rabbit eye)



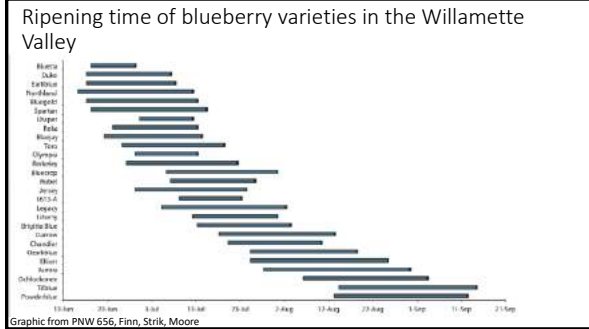
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Cultivars of blueberries

- At least 2 varieties for cross pollination and more fruit
- Early, mid and late-season varieties for season extension, except on the Coast; late season varieties may not ripen.
- Varieties most appropriate for area



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15



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Weeding

- Keep a 4-foot radius around the plant weed free
- Use herbicides sparingly in the first year- Young wood is very susceptible to herbicide damage
- Blueberries have shallow roots and can be outcompeted very easily



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Mulching

- 2-3 inches
- Weed control
- Water retention
- Soil heat modification
- Organic matter



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Pruning blueberries



- Establish good separation between canes on young plants
- Separation and airflow
- Limit new whips (1 year old shoots)
- Whips will eventually replace older growth
- Remove low growth
- Remove damaged and diseased wood
- Remove unfruitful wood
- In old, unpruned stands, you can "stump" the plants, cut them down and allow for regenerative growth

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Pruning



Before pruning



After pruning

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Pruning



3+ year old wood

Whips

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Pruning

1-year old wood

- Fruit buds
- will break in spring to produce a blossom cluster with no leaf growth



- Leaf/vegetative buds
- will break in spring to produce a leafy shoot without flowers

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Pruning



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Pruning



Rejuvenation
AKA 'Stumping'

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Irrigation



- 1 inch per week is sufficient
- Water in the morning
- Can use drip or overhead irrigation (Drip is often more efficient)
- Overhead can be useful in high-heat situations
- Keeping the area around blueberries moist is best. High OM environments can become hydrophobic when dried out

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Fertilization



- Fertilization begins in the spring, around flowering
- On newer, un-mulched plants, use 1.5 tablespoons of 10-10-10
- Add 10-10-10 in spring
- Use 2 ounces on year two, and increase by 1 oz. per year up to 6-8 oz.
- To lower pH, use ammonium sulfate or elemental S.

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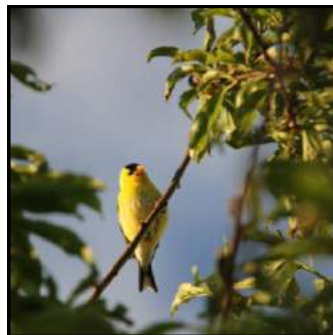
Vertebrate pests



- Birds
- Deer
- Dogs
- Voles
- Moles
- Gophers
- Mice

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Vertebrate pest control



- Fencing for deer and dogs
- Bird netting
- Gopher/Vole/Mole traps

Photo Credit: Betsy Hartley

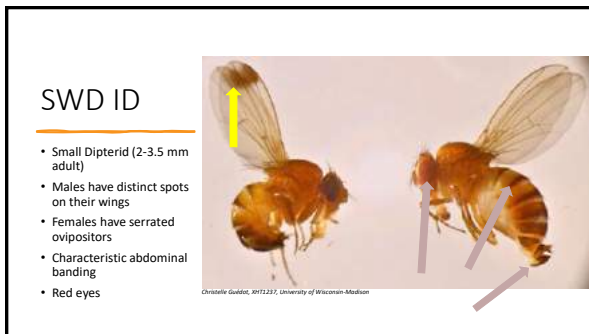
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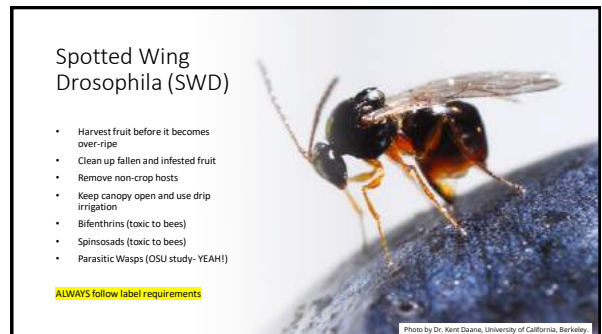
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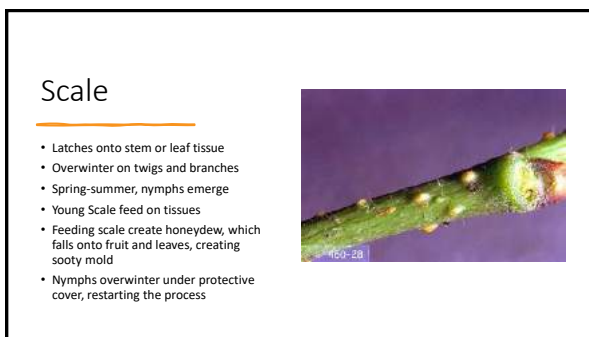
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Scale



Oak lecanium scale insects on an oak stem that are covered with crawlers.

Photo by Joe Baker, NC State University

- Scrub off insects
- Prune branches with especially bad infestations
- Avoid excessive N inputs
- Horticultural oil
- Insecticidal soap

ALWAYS follow label requirements

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Fungal bacterial, Viral pathogens

- Botrytis (Gray mold)
- *Monilinia vaccinii-corymbosi* (Mummy berry)
- Agrobacterium (Crown gall)
- Pseudomonas (Bacterial Blight)
- Shock
- Scorch



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Botrytis

- Commonly called grey mold
- Happens when flowers or berries are exposed to wet conditions
- Fung! needs moisture to germinate
- Some biologicals available



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Mummy berry

- Fungal disease
- Brown, withering flowers
- Hard, mummified, shriveled berries
- Infects both the shoots and fruits of plants
- Fungal bodies (Ascocarps) are small, brown, in soil
- Fruits from old, infected berries

ALWAYS CONSULT THE LABEL ON CHEMICAL PRODUCTS

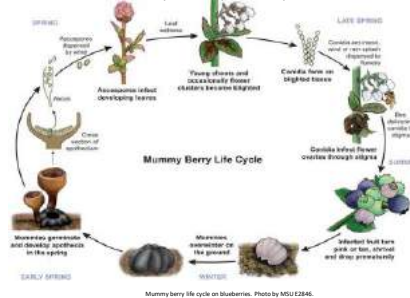
Jay W. Pscheidt, 2013



Jay W. Pscheidt, 2010

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Mummy berry life cycle



Mummy berry life cycle on blueberries. Photo by MSU E246.

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Mummy Berry control

- Prune out infected shoots
- Remove and destroy infected berries
- Apply 2-inches of Doug fir sawdust in spring
- Actinovate AG (Pre-bloom)
- Regalia (Late season apps may cause russetting)

ALWAYS follow label requirements



Note maturing apothecia growing on a single mummy. Photo by Timothy Miles, MSU.

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Shock

- Viral pathogen
- Lasts 1-4 years
- Dependent on variety, will cycle through on its own or kill plant
- Plant resistant varieties
- Prune out very weak wood
- Avoid planting in areas with poor drainage

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Phytophthora cinnamomi (Root rot)

- Oomycete, soilborne
- Survives and spreads very well in water
- Warm weather pathogen
- Thought to have been introduced through ballast in ships
- Can spread through infested nursery stock
- Causes rapid decline of plants as it kills roots, eventually killing plants

Maryna Sordani, 2011.

46

P. Cinnamomi treatment

- Solarize prior to planting
- Plant disease free plants
- Provide good aeration for roots (amend with sawdust or bark mulch)
- Sanitize pots before reusing them
- Destroy diseased plants
- Consult your local agent for chemical recommendations



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Nutrient deficiencies/pH issues

- Nutrient deficiencies and overfertilization can cause disease like symptoms
- Take a soil and tissue sample
- Consult your local agent

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Harvest

- Most varieties ripen in a 2-5-week period
- Once berries are fully blue, give them a few days before picking
- Pick once a week
- Good, ripe berries will "roll" off the stem.

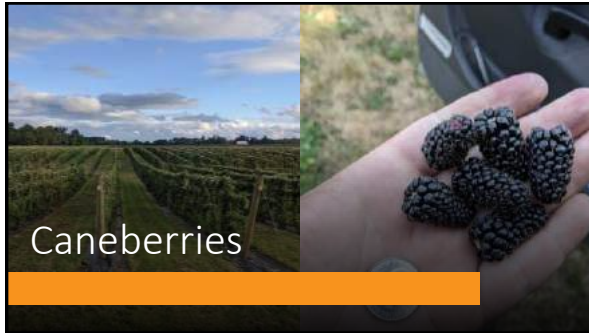


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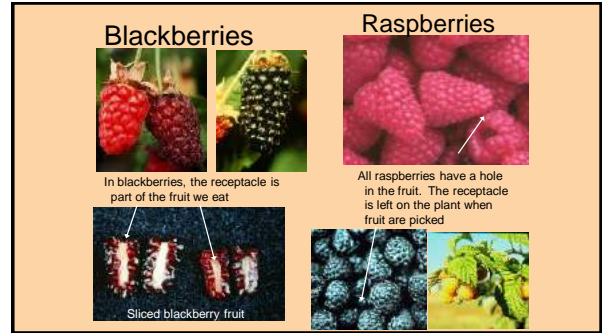
Break

Take 15 minutes

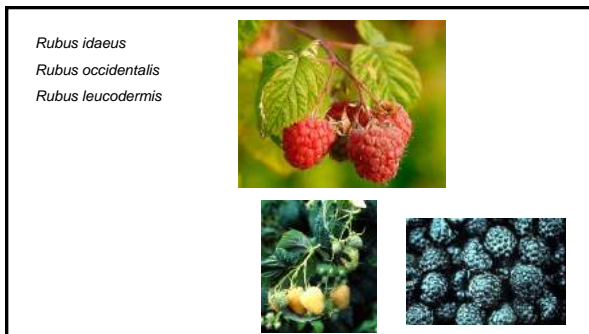
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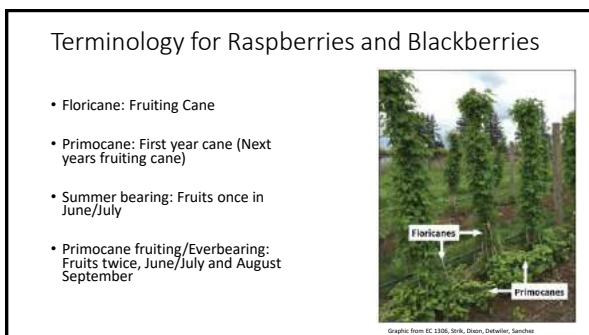
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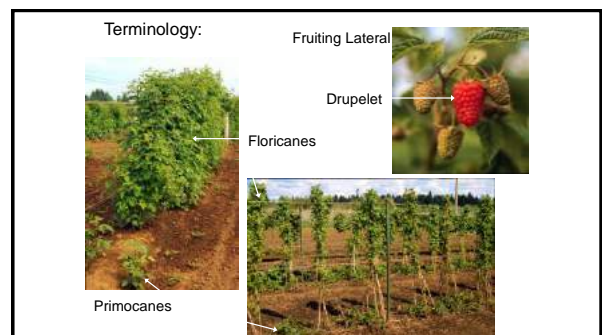
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Fruiting types for Caneberries

Summer-bearing

- Once fruiting
- June/July



Primocane fruiting

- Twice fruiting
- June/July and
- August/September



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Site selection

- Lots of sun!
- Neutral pH
- Well drained soil
- Plan for raised beds where possible

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Planting and establishment

- Sample the soil, and adjust pH as needed prior to planting
- Mound soil so that canes can be planted on hills
- Plant at container height, or if planting bare-root, lay roots flat in shallow hole
- Trellis in second year



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Planting Establishment:

Summer-bearing Raspberries



New primocane growth
(on a raised bed)

At the end of year 1

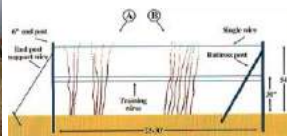
These young, short
primocanes will produce
a small crop in year 2



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Trellising

Photo by Bernadine Strick, © Oregon State University



Graphic from Steve Rasmussen

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T-style Trellis



Support wire

- Less expensive
- Can't hold as much weight
- Adjustable support wires

Cross Arm U-bolted on

T Post

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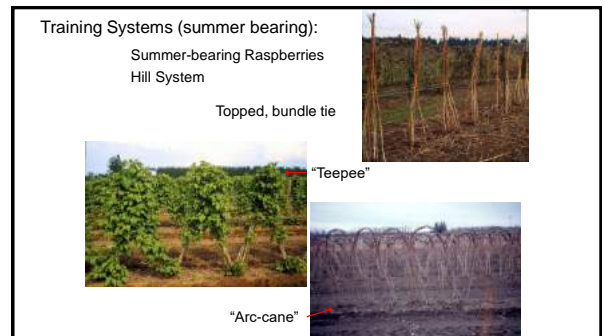
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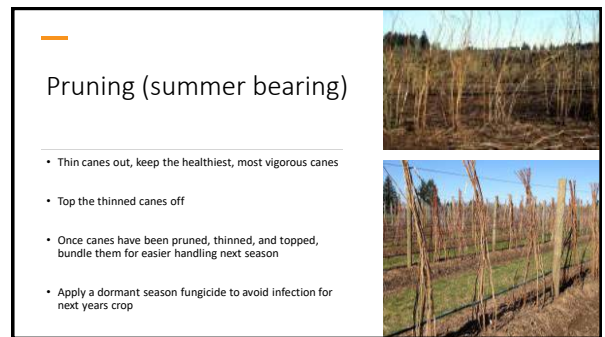
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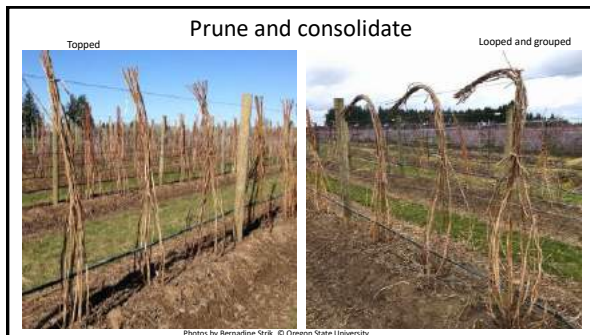
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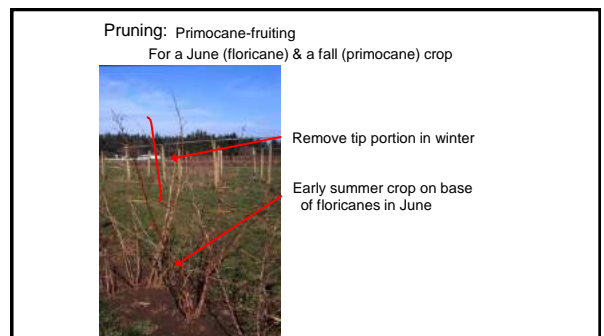
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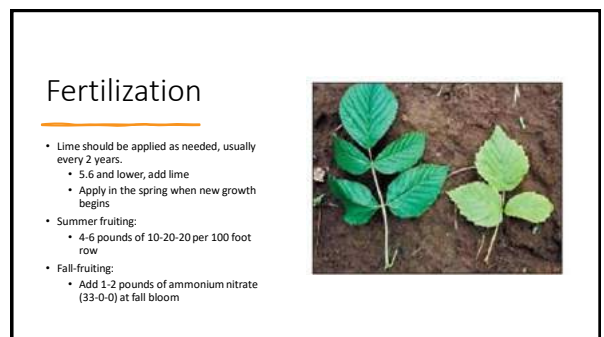
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Vertebrate pests



- Birds
- Deer
- Dogs
- Voles
- Moles
- Gophers
- Mice

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Vertebrate pest control



- Fencing for deer and dogs
- Bird netting
- Gopher/Vole/Mole traps
- Make environment less favorable
- Rodenticide baits (Consult label & local agent)

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Invertebrate pests

- Spotted Wing Drosophila (SWD)
- Aphids
- Leafhoppers
- Borers
- BSMB (Brown marmorated stink bug)
- Weevils
- Slugs
- Lepids
- Mites



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Spotted Wing Drosophila (SWD)

- Non-native species
- Oregon resident since 2010
- Can survive 3-9 weeks in season
- Later generations can overwinter
- 10-14 generations a season
- Don't like heat
- Does like humidity
- Females lay eggs in fruit (1-3 per fruit)
- 1 female = 300 eggs
- Usually monitored using baited traps



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Spotted Wing Drosophila (SWD)

- Harvest fruit before it becomes over-ripe
- Clean up fallen and infested fruit
- Remove non-crop hosts
- Keep canopy open and use drip irrigation
- Bifenthrins (toxic to bees)
- Spinosads (toxic to bees)
- Parasitic Wasps (OSU study- YEAH!)
- **ALWAYS follow label requirements**



Photo by Dr. Kent Daane, University of California, Berkeley

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Borers

- Holes in wood and crowns
- Galls
- Duff in holes
- Declining branches and stems



© Ken Gray Insect Image Collection



© Ken Gray Insect Image Collection



Justin O'Dowd, Washington State University

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Borer management

- Any insecticides used need to target adult emerging stage
- Almost impossible to kill larval stage in wood
- Destroy infested wood and crowns
- Bury any infested material deeper than 2 inches
- Remove wild blackberries and other hosts in the area
- Intensive pruning

ALWAYS follow label requirements



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Fungal, Bacterial, Viral pathogens

- Botrytis
- Powdery mildew (Marionberries)
- Rust
- Purple Blotch
- Agrobacterium



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Botrytis (Gray mold)

- Does very well in humid conditions
- Can show up pre-harvest or post-harvest
- Overwinters in canes, leaves and mummified fruit
- Spores require free water to infect
- Infects fruit and canes
- Causes fruit to mold and mummify



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Botrytis management

- Airflow is key
- Keep plants dry as much as possible
- Remove dead leaves
- Destroy old fruit
- Use drip irrigation
- Some biologicals available, consult your local agent

ALWAYS follow label requirements



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Agrobacterium (Crown & Cane Gall)

- Bacterial infestation
- Infested through injuries to the plant
- DNA from bacteria transfers into plant, causing tumors to form
- Disinfect pruning tools
- Prune when dry
- Solarize the soil prior to planting
- Remove infested plants



85

Common Problems in the Home Garden Diseases - Viruses



Raspberry Bushy Dwarf Virus
RBDV



There is no control for infected plants

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Root rots

- Multiple causal agents
- *Armillaria*
- *Phytophthora rubi*
- Causes cane collapse
- Root die-off
- Plant resistant varieties
- Plant in well drained soils
- Use certified stock



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Strawberries

Adapted from Strawberry presentation by Steve Renquist

88

Site selection

- Full sun
- Well-drained soil
- Neutral pH
- Check for Verticillium if planting in ground that was previously strawberries



Lynn Ketchum

89

Terminology:

Crown: short compressed stem -- has a whorl of leaves and produces trusses and runners

Runner



Mother plant daughter

Truss



Cap



"seeds" are called achenes

90

Strawberry production categories

June Bearing

- Fruits once a year
- Produces many runners
- Very high sugar content

Day-neutral

- Produce fruit continuously May through October
- Produce few runners

Everbearing

- Produce fruit twice: June & August
- Produce few runners



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Cultivars: June-bearers

Hood


- Early
- Large berry size
- Excellent flavor
- Poor texture for freezing
- Sensitive to virus



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Cultivars: June-bearers


Shuksan



- Mid-season
- Medium berry size
- Good flavor
- Rough shape

Totem


- Mid-season
- Large berry size
- Good flavor
- Good for freezing



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Cultivars: June-bearers


Puget Reliance



- Mid-season
- Large berry size
- Good flavor
- Nice shape

Benton


- Mid- to late-season
- Medium berry size
- Good for freezing



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Cultivars: June-bearers



Rainier



- Late-season
- Medium berry size
- Good flavor
- Nice shape


Firecracker

- Late-season
- Large berry size
- Very good flavor
- Good for freezing
- High yield

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Cultivars: June-bearers



Independence


- Late-season
- Large berry size
- Excellent flavor
- Good for freezing
- Difficult to cap
- Tolerates root weevil
- Cold hardy

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Cultivars: June-bearers

Tillamook

- High yields
- Large – very large berry size
- Excellent flavor
- Very good quality
- Excellent fruit size in 2nd harvest season



Pinnacle




- Large berry size
- Very good flavor

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Cultivars: Ever-bearing

2 Crops per year


Ft. Laramie



- Small to medium berry size
- Sweet flavor
- Medium firmness
- Poor capping

- Medium berry size
- Fair flavor
- Very soft

Ozark Beauty & Quinault




98

Cultivars: Day-neutrals


Continuous ripening

Seascape



- Large - very large berry size
- Good flavor
- Firm


Selva



99


Cultivars: Day-neutrals

Tribute



- Small-medium berry size
- Good/Excellent flavor

Tristar



- Small-medium berry size
- Good/Excellent flavor

100

Container/greenhouse production:

Day-neutral types are best suited to greenhouse or container production. Dayneutrals will fruit almost continuously in a greenhouse for off-season production




101

Planting Systems:


Matted Row:

- 15" in the row;
- 3-4' between rows
- runners root
- Rows will form a mat


Hill System:

- 12" in the row (single or staggered double rows)
- Remove runners


Mature matted row



Planting Year






Mature hill system



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Planting Systems:

Plants can be established on either flat ground or raised beds (recommended)

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Planting and establishment:

Planting Year (year 1):

- In June-bearers, remove blossoms
- In other types, remove first flush of flowers
- Remove runners in hill systems

Fruiting Seasons (years 2-4):

- In June-bearers, harvest fruit starting year 2
- Fruit size decreases year 2 to 4
- Replant after the fourth year



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Fertilization:

First year plantings: (all types)

- 2 oz. of Nitrogen per 10' row
- Use a balanced fertilizer
- Apply 2-3 times after planting

Established:

- June-bearing – after renovation
- Others – throughout the season



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Maintenance:

Watering

- Apply 1-1.5" of water per week
- Most important during fruit set
- Amount of water varies based on soil type, etc.

Weed control

- Important – cultivate shallowly
- May use sawdust, mulches, or plastics



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Maintaining Plantings:

"Tired" field after harvest in July



Renovation

- Only done in June-bearers
- Mow plants just above crown 2 weeks after last fruit harvest
- Fertilize & irrigate after mowing



Renovating a commercial field



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Common Problems in the Home Garden

Diseases - Botrytis



Most effective control for gray mold in the home garden are cultural ones:

- Keep an open canopy
- Avoid watering late in the day
- Pick diseased fruit and discard
- Renovate June-bearers and destroy leaves
- Pick any fall fruit to avoid having diseased "mummies" in the plot over winter

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Common Problems in the Home Garden

Diseases - Leaf Spot and Scorch



Leaf Spot

Leaf Spot:

- A wet weather problem
- Not critical on leaves
- Symptoms on fruit



"Black seed"

Leaf Scorch:

- Spots do not have gray centers
- Some cultivars sensitive
- Not worth trying to control either disease



Leaf Scorch

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Common Problems in the Home Garden

Diseases - Powdery Mildew



Not considered an important problem in strawberry

- Curling and "bronzing" of leaves usually not seen until late in season

- Symptoms sometimes on fruit



110

Common Problems in the Home Garden

Diseases - Root Rot

Weak areas in plantings and plant death



- Plant disease-free stock
- Avoid susceptible cultivars
- Plant on well-drained sites
- Use raised beds
- Avoid over irrigating

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Common Problems in the Home Garden

Insects - Root Weevils



Larvae:

- Damage to plants comes from feeding of larvae on roots & crowns



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Common Problems in the Home Garden

Insects - Slugs

- Use baits
- Control most effective if done after first heavy late-summer rain. Baiting at this time kills egg-laying adults



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Common Problems in the Home Garden

Insects - Spotted Winged Drosophila



- Trap and monitor for SWD
- Keep fields clean and picked
- Check with your extension agent for chemical recs.

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Common Problems in the Home Garden

Frost damage

- Open flowers damaged < 30 °F
- Floating row covers offer some protection



Healthy Flower

Fully frost-damaged flowers produce no fruit



Frost-damaged flowers

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Common Problems in the Home Garden

Frost damage

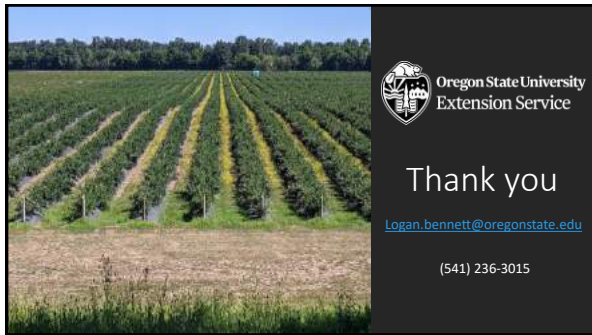


Just the tip of this flower was damaged by frost

Partially damaged flowers produce "nubbins", "cat-faced", or "monkey-faced" berries



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