



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



3

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?



4



Already have plants in the ground? Take a tissue sample!

5



6

About Blueberries

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



7

Blueberry root systems

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



8



Site selection

9

Site selection

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



10

Site selection

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



11

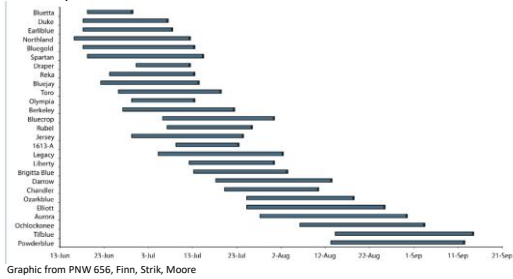
Cultivars of blueberries

- 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



12

Ripening time of blueberry varieties in the Willamette Valley



13



Choosing varieties

- Pick varieties that bloom and fruit around the same time for pollination
- You can pick multiple varieties to plan for a season-long harvest
- U-pick farms are a great place to sample varieties

14



Pre-plant prepping

- Take a soil sample before planting
- Amend with elemental sulfur to adjust pH before planting if needed
- Add OM if needed
- Peat, Compost, Sawdust

15

Raised Bed or Flat Ground?

- **Raised Beds**
 - Ease of soil modification
 - Increased drainage
 - Watering can be a challenge
 - Easier to weed
- **Flat Ground**
 - Ease of maintenance
 - Lack of erosion
 - Ease of damage
 - Harder to weed



16

Planting

- Can plant from containers or bare roots
- Plant in the fall or in the early spring
- Space 5 feet apart
- If planting in rows, allow 7-10 feet in between rows
- If using weed mat, plan out holes before planting
- Break up roots and plant at pot height
- Water in the plants- **Don't fertilize the holes!**



18

First year

- Remove any flowers and fruit
- Keep the area clean and weed free
- Add mulch to the plants: 2-3 inches of sawdust



19

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



20

Mulching

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



Weeds:
None in mulched
Present in bare

21




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

22

Pruning



Before pruning After pruning

23

Pruning




3+ year old wood

Whips

24

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

25

Pruning



26

Pruning



Rejuvenation
AKA 'Stumping'

27

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

28

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 per year two, and increase by 1 oz. per year up to 6-8 oz.
- To lower pH, use ammonium sulfate or elemental S.

29

Fungal bacterial, Viral pathogens

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



30



Botrytis

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

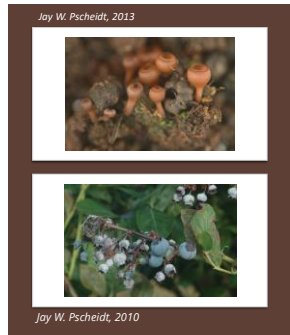


31

Mummy berry

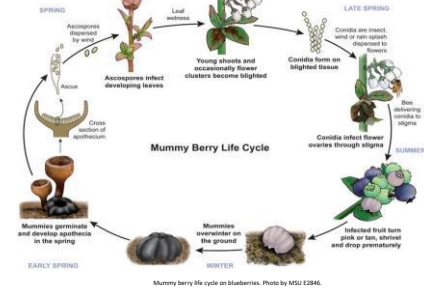
- Fungal disease
- Brown, withering flowers
- Hard, mummified, shriveled berries
- Infects both the shoots and fruits of plants
- Fungal bodies (Ascocarps) are small, brown, in soil
- Fruits from old, infected berries

ALWAYS CONSULT THE LABEL ON CHEMICAL PRODUCTS



32

Mummy berry life cycle



33

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



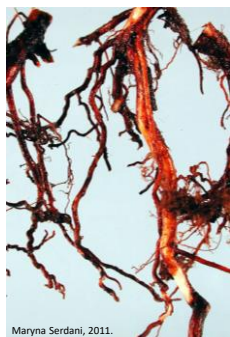
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35

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



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

36

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



37



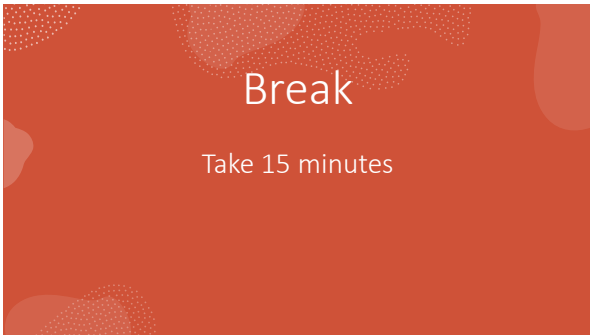
Nutrient deficiencies/pH issues

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

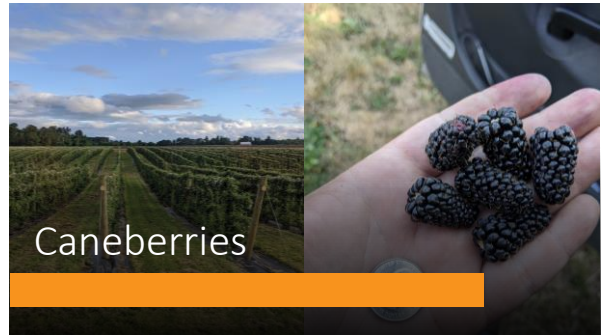
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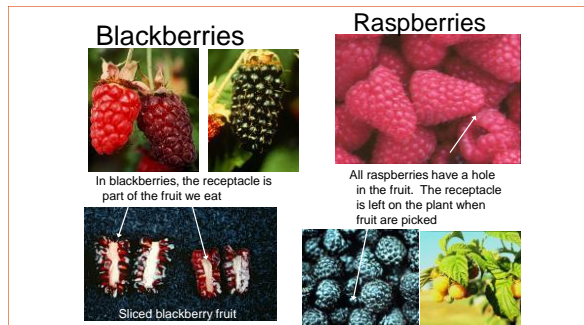
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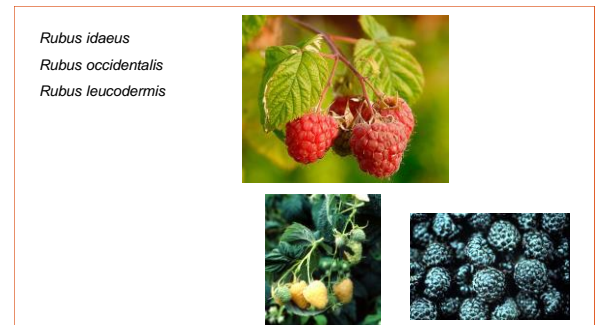
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41



42



43

Blackberries in Oregon

Multiple species grouped by growth patterns

- Trailing
- Erect
- Semi-erect

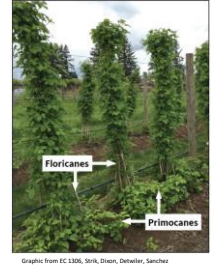
*Boysenberries, Marionberries, and Loganberries are blackberries too!



44

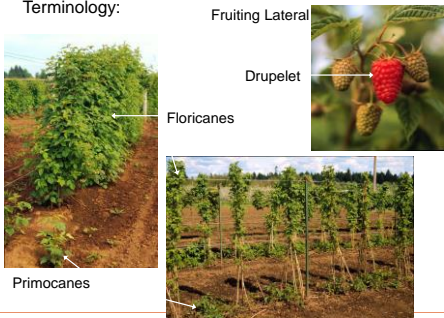
Terminology for Raspberries and Blackberries

- Floricane: Fruiting Cane
- Primocane: First year cane (Next years fruiting cane)
- Summer bearing: Fruits once in June/July
- Primocane fruiting/Everbearing: Fruits twice, June/July and August/September



45

Terminology:



46

Fruiting types for Caneberries

Summer-bearing

- Once fruiting
- June/July



Primocane fruiting

- Twice fruiting
- June/July and August/September



47

Site selection



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

48

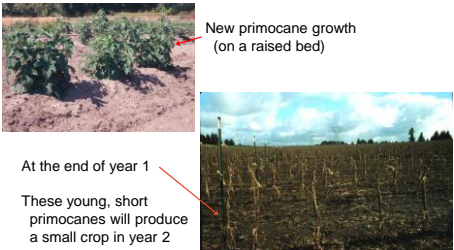
Planting and establishment

- 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



49

Planting Establishment:
Summer-bearing Raspberries

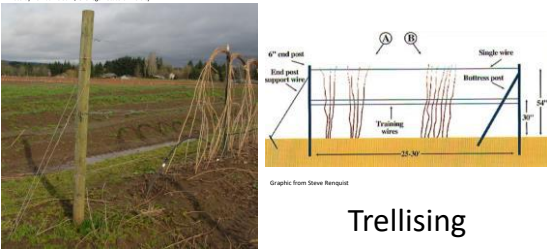


New primocane growth (on a raised bed)

At the end of year 1
These young, short primocanes will produce a small crop in year 2

50

Photo by Bernadine Smith, © Oregon State University




6" end post
4' post support wire
Single wire
Ballpost
Training wires
24' span

Graphic from Steve Renquist

Trellising

51



T-style Trellis

Support wire

Cross Arm U-bolted on

T Post

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

52



Get Creative!

Photo: Neil Bell, © Oregon State University

53

Trellising: Hedgerows


- Plant individuals at 2' apart
- Suckers will fill in the hedge
- Maintain hedge width at 1'-18"



54

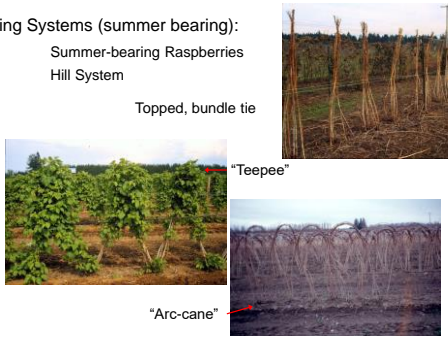
Trellising: Hilling

- Spaced at 2.5'
- Plants are trained in a "hill" formation
- Suckers removed between plants
- Cleaner look



55

Training Systems (summer bearing):
 Summer-bearing Raspberries
 Hill System



Topped, bundle tie

"Teepee"

"Arc-cane"

56

Pruning: Summer Bearing

- End of summer/fall
- Remove any dead floricanes (June bearing)
- Top off old primocanes (Everbearing)
- Look for older, bleached out looking canes



57

Pruning (summer bearing)

- Thin canes out, keep the healthiest, most vigorous canes
- Top the thinned canes off
- Once canes have been pruned, thinned, and topped, bundle them for easier handling next season
- Apply a dormant season fungicide to avoid infection for next years crop



58

Prune and consolidate



Photos by Bernadine Strik, © Oregon State University

59



Arc trained in late winter

Bernadine Strik, © Oregon State University

60


Planting Establishment Fall fruiting (Primocane fruiting):

- Space at 2'
- Can be trellised at knee height: not required
- Mature crop in year 2



61

Pruning: Primocane-fruiting
For a June (floricane) & a fall (primocane) crop



Remove tip portion in winter

Early summer crop on base of floricanes in June

62



Pruning for a fall crop only: primocane fruiting canes

63

Fertilization

- Lime should be applied as needed, usually every 2 years.
 - 5-6 and lower, add lime
 - Apply in the spring when new growth begins
- Summer fruiting:
 - 4-6 pounds of 10-20-20 per 100 foot row
- Fall-fruiting:
 - Add 1-2 pounds of ammonium nitrate (33-0-0) at fall bloom



64

Fungal, Bacterial, Viral pathogens

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



65



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

66

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



67



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

68

Common Problems in the Home Garden Diseases - Viruses



Raspberry Bushy Dwarf Virus RBDV



There is no control for infected plants

69

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



70



Strawberries

Adapted from Strawberry presentation by Steve Renquist

71

Site selection

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

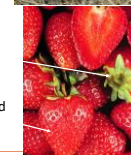


Lynn Ketchum

72

Terminology:

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



73

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



74

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



75

Planting Systems:

Matted Row:

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

Mature matted row



Planting Year

Hill System:

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

Mature hill system



76

Planting Systems:

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



77

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



78

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



79


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




80


Maintaining Plantings:

Renovation


"Tired" field after harvest in July



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




Renovating a commercial field



81

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

82

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

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

83


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




84

Common Problems in the Home Garden

Diseases - Root Rot

Weak areas in plantings and plant death



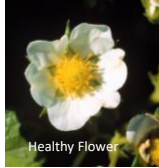
- Plant disease-free stock
- Avoid susceptible cultivars
- Plant on well-drained sites
- Use raised beds
- Avoid over irrigating

85

Common Problems in the Home Garden

Frost damage

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



Fully frost-damaged flowers produce no fruit

Frost-damaged flowers



86

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



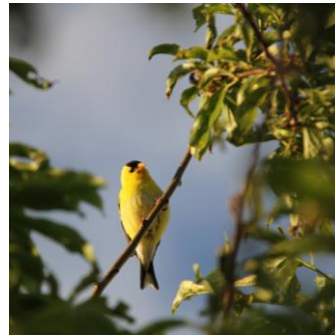
87

Vertebrate pests



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

88



Vertebrate pest control

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

Photo Credit: Betsy Hartley

89

Insect Pests

- Spotted Wing Drosophila (SWD)
- Scale
- Aphids
- Leafhoppers



90

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



91

SWD ID

- Small Dipterid (2-3.5 mm adult)
- Males have distinct spots on their wings
- Females have serrated ovipositors
- Characteristic abdominal banding
- Red eyes



Christelle Gudaci, 2012257, University of Wisconsin-Madison

92

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.

93

Scale

- Latches onto stem or leaf tissue
- Overwinter on twigs and branches
- Spring-summer, nymphs emerge
- Young Scale feed on tissues
- Feeding scale create honeydew, which falls onto fruit and leaves, creating sooty mold
- Nymphs overwinter under protective cover, restarting the process



460-28

94

Scale



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

Photo by Jim 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

95

Borers

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



74-4
© Ken Gray Insect Image Collection



Justin O'Dea, Washington State University

96

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



103-20

97

Common Problems in the Home Garden

Insects - Root Weevils



Larvae:

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



98

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



99

Tree fruits



100

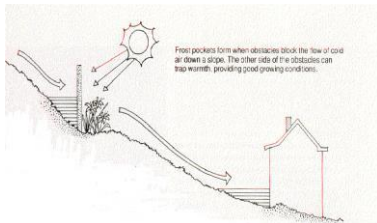
Site Selection: What to look for

- Growing zones 6, 7, or 8 for deciduous tree fruit
- Lots of light: Eight hours of sun
- Look for elevation
- Avoid frost pockets
- Slope direction influences bud break
- Make sure you have water!
- Well-drained soil



101

Frost pockets and warm spots



102

Let's talk about soils

- Well-drained soil is best for all fruit trees
- Apricot and Cherry trees very sensitive to water
- Peach trees are sensitive to water
- Apples are more tolerant to waterlogging (M26 and MM106 exempt)
- Plums tolerant to water
- Pears very tolerant



103

Rootstocks and planting



110

Should you plant dwarf varieties- or prune to dwarf?

Benefits of dwarfing fruit trees:

- Safer- little to no ladder work
 - pruning/training
 - harvesting
 - spraying
- Begin flowering earlier (precocious)
- Bear fruit earlier
- More Productive
- Less pruning

111

What fruit trees can be dwarfed?

- Significant dwarfing
 - Apple- 4-6'
 - Cherry- 8+
 - Peach- 8+
- Slight dwarfing
 - Pear- 10+
 - Plum- 8+

112

Prune to your intended goal



113

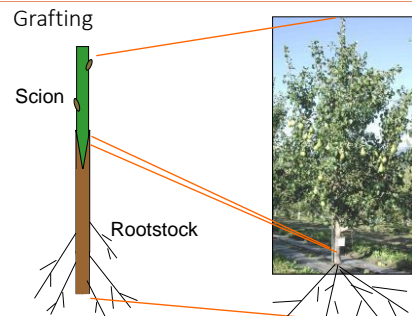
How do you dwarf fruit trees?

Dwarfing rootstocks

- genetically different root system
- variety is budded/grafted onto a rootstock
 - not true from seed
 - varieties are difficult to root
 - not dwarfing



114



115

Planting systems



116

Planting

- ✓ Deciduous fruit trees planted bare-root.
- ✓ Planting holes dug wide.
- ✓ Do not fertilize in the planting hole.
- ✓ Broken or damaged roots trimmed off.



117

Planting



- Trees planted with graft union above the soil line.
- Trunks painted with white interior latex paint (can be diluted with water 1:1).
- Water trees in.
- Prune off top at desired height to encourage branching.
- Don't put fertilizer in hole or around tree base until 2nd year.

118

Pruning after planting

- Central leader training
- If not branched, head the tree at ~30"
- Allow 4-5 lateral branches to develop (not all from the same location on the trunk)



119

Plant Spacing

- Dwarf
 - 6-8 foot spacing
- Semi-dwarf
 - 10-15 ft spacing
- Standard
 - 18-25 ft. spacing



120

Fertilization



121

Accumulated Dry Matter: Example

- Six-year-old Gala trees on M26 roots
- Tree accumulates 10 lbs. DM per year
- 72% to fruit
- 17% to shoots and leaves
- 11% to trunk and roots

122

Fertilization

- Apply nitrogen fertilizer during the growing season. (April/May)
.5 lb. per tree actual N for trees 1-8 years old
- Early season application will promote growth in the current season.
- Aug-Sep application will be stored in buds for flowers-fruit during the following season. Foliar 1lb. urea for 4 gallons of water

123

Fertilization-pH

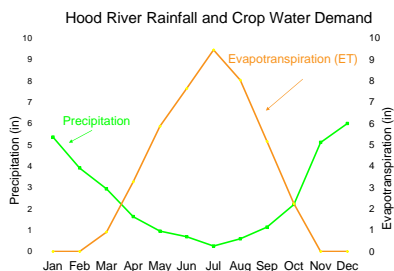
- Young trees should grow 18-30 inches
- Older trees should grow 12-18 inches
- pH of 6-7 good, lime every third year

124

Irrigation



125



126

Irrigation Needs (inches/week)

	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov
<u>Roseburg</u>									
Apples, Cherries	0.1	1.6	4.4	6.2	8.6	7.0	3.8	0.2	0.0
Pears, Plums	0.1	1.4	3.9	5.7	7.9	6.4	3.4	0.2	0.0
<u>Grants Pass</u>									
Apples, Cherries	1.3	3.7	6.7	8.2	10.3	8.6	5.4	2.0	0.0
Pears, Plums	1.3	3.5	6.1	7.5	9.5	8.0	4.9	1.9	0.0

EM 8530

127

Let's talk thinning! Why do we thin fruit?

- Fruit size
 - apple, pear, peach, plum
- Return bloom
 - mostly in apple
- Prevent limb breakage
- Distance
 - at least 6" (fist with extended thumb)
 - < 25% of the crop in apple and peach

128

Fruit Thinning-Heavy Set



129

Fruit Thinning Each Cluster



130

Thin to Singles



131

Fruit thinning

- Apple < 40 days after full bloom
 - 1 fruit / 2 spurs
- Pears < 60 days after full bloom
 - 1 fruit/ 2 spurs
- Peaches < 60 days after full bloom
 - 6" to 10" apart

132

Pruning



133

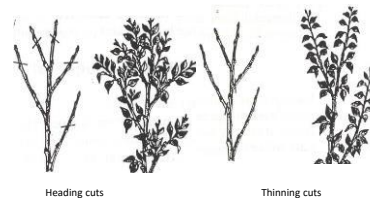
Why Prune?

- Balance vegetative growth and flowering-fruiting
- Pruning + fertilization = vigor, large fruit
- No pruning + heavy crop load = weak trees, small fruit size

134

Pruning

- Heading back cuts
 - invigorating
 - lateral buds break
 - increases branching
- Thinning out cuts
 - branch collars
 - equal but opposite
 - stimulate apical shoot elongation
 - reduce branch number



135

Training Systems – Central Leader



136

Super Spindle System



137

Bibaum System (Double Axis)



138

Open Center Vase



139

Open Center Vase (old)



140

Diseases

Apple scab



Fireblight



141

Codling Moth – Apple and Pear Pest



142

Voles



143

Olives



144

Site selection

- Climate is important in site selection
- Olives do well with mild winters and warm summers
- Sites that frequently achieve temperatures below freezing will harm or kill the trees
- Review site history (avoid sites where verticillium may be present)
- Assess access to water
- Choose a site with full sun



145

Soils

- Olives prefer well drained soils
- pH tolerant (6.5-8.5)
- Can grow in marginal soils
- Will perform better in higher quality soils
- Soil profile should be 3-4 feet
- Unstratified



146

Fertilizer

- Trees tolerate low fertility better than most any fruit tree
- Too much nutrients lead to excessive vegetation and low fruit
- Nitrogen is most important (40-100 lb N/A in CA)
- Boron important trace element
 - Better obtained from soil
- Tissue testing in July (CA)



147

Irrigation

- Irrigation for establishment
- After is not required for tree survival
- Irrigation requirements not determined for Oregon



148

Cold tolerance

Susceptibility to cold is significant limitation
Olive cultivars are known to vary in their tolerance of freezing temperatures
Information on relative cold hardiness is scarce



149

Growth and Fruit Production

- Alternate bearing
- Olives bear fruit on last year's growth
- Shoot expansion occurs most on non-bearing branches
- Fruiting branches experience less vegetative growth



150

Olive Propagation

- Dip n Grow (IBA + NAA) and Hormex (IBA) at 2 different rates
- Trials found spring and fall typically best times to propagate
- Mixes of peat, perlite and coir
 - 1:1 peat:perlite most effective
- Worked with Picual, Leccino, Arbequina, Grignan, Frantoio
- Rooting percentages varied widely, 25-96%



151

Olive Production Areas



- Semi-Mediterranean climate in valleys west of cascades – still, winter lows can drop to temperatures damaging or lethal to olives
- Temps below 20° will kill small branches, below 12-15 ° severe damage to death

152

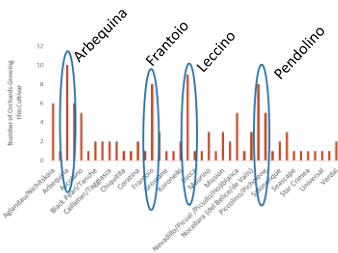
Annual Growing Degree Days (GDD) by location

Cordoba, Spain.....	5,220°F
Florence, Italy.....	4,129°F
Nyons, France.....	2,750°F
Torbole sul Garda, Italy.....	3,272°F
Austin, TX.....	7,024°F
Corning, CA.....	5,062°F
Medford, OR.....	3,128°F
Roseburg, OR.....	2,729°F
Salem, OR.....	2,437°F

Base 50°F, Cap 86°F.
Source: weatherspark.com

153

Olive Cultivars Grown in Oregon



154

Pests and Disease

- Peacock spot
- Leaf rollers/tiers
- scale



Photo: Neil Bell

155

Emerald Ash Borer



- America's most destructive forest pest to date
- June 30, 2022, found in Joseph Gale Elementary, Forest Grove
- Low density, difficult to detect

156



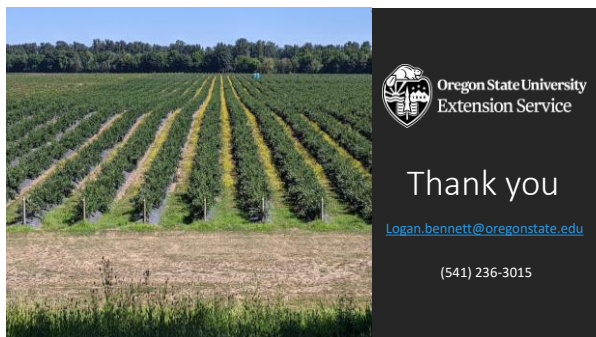
D-shaped exit holes



S-shaped galleries



157



158