Growing Small Fruit Commercially

Beginning Farmer & Rancher Program
BF 105

Mary Concklin
Visiting Extension Educator, Fruit Production and IPM

SOLID GROUND FARMER TRAININGS

Strengthening Our Farms Across Connecticut

Visit newfarms.extension.uconn.edu/solidground for the full schedule of trainings offered in collaborations with our **Agricultural Learning Partners:**

- Common Ground, New Haven
- Community Farm of Simsbury, Simsbury
- Green Village Initiative, Bridgeport
- Killingly Agricultural Education Center, Killingly
- Knox- Urban Farming Incubator Program, Hartford
- Grow Windham, Willimantic, Windham
- Listo Para Iniciar Program, Bethel, Stamford, New Milford

Growing Small Fruit Commercially

Related Resources

Resources: UConn Extension

- Fruit production and IPM: Mary.Concklin@uconn.edu
- Greenhouses: Leanne.Pundt@uconn.edu, Rosa.Raudales@uconn.edu
- Food Safety: Diane.Hirsch@uconn.edu
- Business & Risk Management: Joseph.Bonelli@uconn.edu
- Pesticide Education: Candace.Bartholomew@uconn.edu
- Food Systems: Jiff.Martin@uconn.edu
- Plant Diagnostics: Joan.Allen@uconn.edu
- UConn Soils Lab: Dawn.Pettinelli@uconn.edu, Thomas.Morris@uconn.edu

Opportunities: Fruit Production & IPM

- Crop Talk: Vegetable & Small Fruit Newsletter
- UConn Fruit IPM Message via email, website
- New England Vegetable & Fruit Conference
- CT Vegetable & Small Fruit Growers' Conference
- New England Small Fruit Production Guide
- Special Topic Workshops/Conferences/Twilight Meetings
- Beginning Farmer Training Courses
- UConn IPM Website (www.ipm.uconn.edu/)/fact sheets
- Phone/email/on-farm consultations/trainings

Other Farm Resources:

- CT Agricultural Experiment Station
- USDA Natural Resource Conservation Service (NRCS)
- USDA Farm Service Industry (FSA)
- CT Department of Agriculture (CT DoAg)
- CT Department of Environmental and Energy Protection (DEEP)
- CT Farm Bureau
- CT New Farmers' Alliance
- NE Vegetable & Berry Growers' Association
- NE SARE

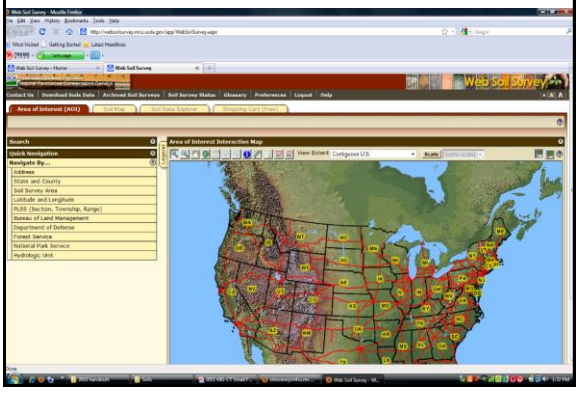
Growing Small Fruit Commercially

Pre-Plant Considerations

Need To Ask Yourself

- What do you want to grow OR what does your market want you to grow
- How are you going to market the crop
- PYO insurance
- Do I have enough space for the type of market
- Do I have the capital
- Food safety plan
- Pollination options

http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx



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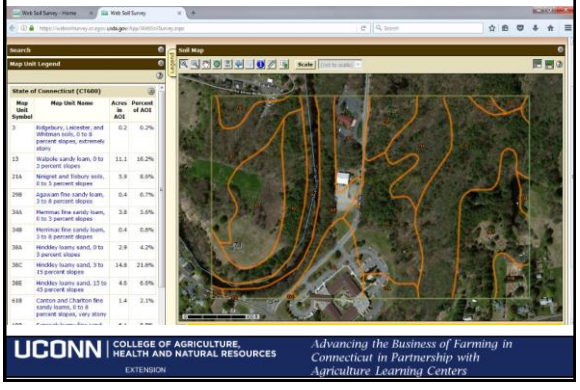


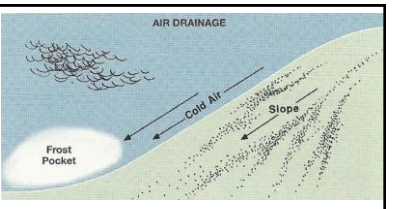
Compaction

- < ½" per hour → poorly drained soil
- ½" – 1" per hour → moderately well drained
- > 1" per hour → well drained

Site Selection

- Well drained soils
- Organic matter at least 3%
- Full sun
  - Currants and Alpine strawberries will do OK in partial shade

Topography



Critical Temperatures

Blueberry	TC	Early Pink	Late Pink	Bloom - PF
	20-23	23-25	24-27	28
Grape	Full Swell	Bud Burst	1st leaf	2nd-4th leaf
	21	25	27	28
Strawberry	Tight Bud	Popcorn	Open Blossom	Fruit Set
	22	26	30	28
Bramble				Full Bloom
				28

Temperatures in degrees Fahrenheit

Site Selection

- Well drained soils
- OM at least 3%
- Full sun
  - Currants and Alpine strawberries will do OK in partial shade
- Topography
- Avoid planting in sod

Get rid of weeds, sod

Existing vegetation

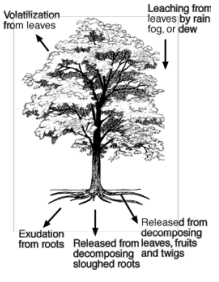


Diagram courtesy of VA Tech

- Blackberry, blueberry and **Black walnuts** don't go together.

Cover Crops

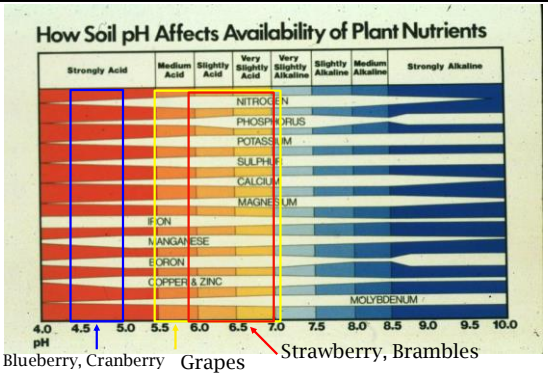
- Increase OM
- Add nitrogen
- Loosen compacted soil
- Attract beneficial insects
  - Clover, mustard flowers
- Reduce soil erosion
- Suppress weeds

Veggiegardeningtips.com

Cover Crops

Indiana Museum of Art

- Annual ryegrass, oats, buckwheat do not overwinter
- Legumes: clovers, fescue, hairy vetch
- Non-legumes: wheat, oats, forage radishes, rye, barley, buckwheat, mustards



Nutrient Deficiencies

Nutrient in excess	Induced deficiency
Nitrogen (N)	K
Phosphorus (P)	Cu
Potassium (K)	N, Ca, Mg
Sodium (Na)	K, Ca, Mg
Calcium (Ca)	Mg, B
Magnesium (Mg)	Ca
Iron(Fe)	Mn
Manganese (Mn)	Fe
Copper (Cu)	Fe

Rabbiteye

Vaccinium virgatum (also known as *V. ashei*)

- Native to southern USA
- Ripen late May – late July

Lowbush blueberry

Vaccinium angustifolium

- Low spreading
- Spread by underground rhizomes
- Wooded or open areas
- Wild or managed stands
- Harvest late July - August

Half-high blueberry

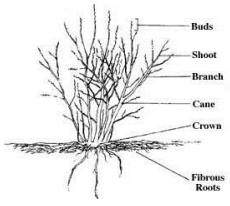
Vaccinium corymbosum x V. angustifolium

- Northcountry, Northblue, Northsky, Northland, Chippewa, Polaris
- Exceptional cold hardiness

Highbush Blueberries

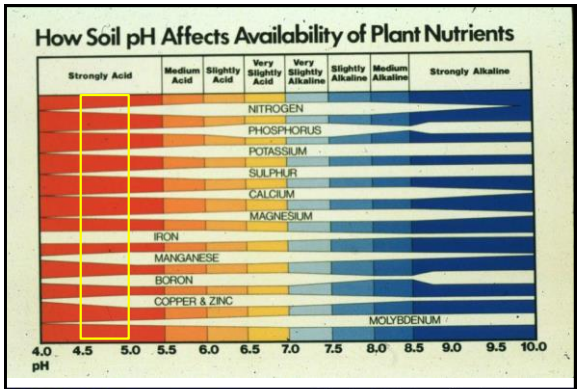
Vaccinium corymbosum

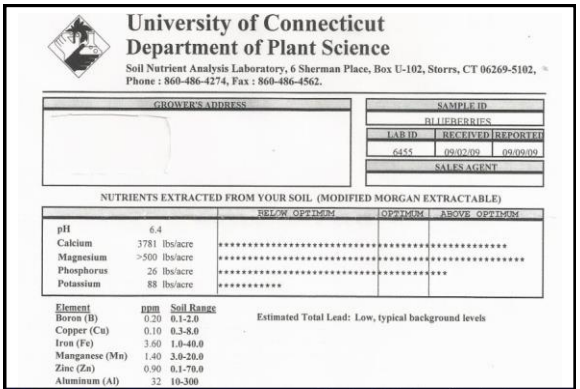
- Indigenous to North America
- 1st successful hybridization was in 1911
- Grown commercially beginning in 1930s



- Root system 6" – 12" deep
- Grows between and within soil and mulch
- Canes develop at crown
- Sensitive to changing water conditions

1. pH !
2. pH !
3. pH !





University of Connecticut
Department of Plant Science

Soil Nutrient Analysis Laboratory, 6 Sherman Place, Box U-102, Storrs, CT 06269-5102,
Phone : 860-486-4274, Fax : 860-486-4562.

GROWER'S ADDRESS

SAMPLE ID: BLUEBERRIES
LAB ID: 6455 | RECEIVED: 09/07/09 | REPORTED: 09/09/09
SALES AGENT

NUTRIENTS EXTRACTED FROM YOUR SOIL (MODIFIED MORGAN EXTRACTABLE)

			BELOW OPTIMUM	OPTIMUM	ABOVE OPTIMUM
pH	6.4				
Calcium	3781	lbs/acre	**********		
Magnesium	>500	lbs/acre	**********	**********	**********
Phosphorus	26	lbs/acre	**********		
Potassium	88	lbs/acre	**********		

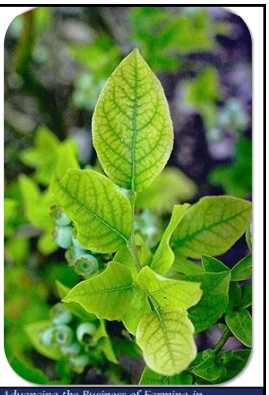
Element	ppm	Soil Range
Boron (B)	0.20	0.1-2.0
Copper (Cu)	0.10	0.3-8.0
Iron (Fe)	3.60	1.0-40.0
Manganese (Mn)	1.40	3.0-20.0
Zinc (Zn)	0.90	0.1-70.0
Aluminum (Al)	32	10-300

Estimated Total Lead: Low, typical background levels

Amount of Sulfur in Pounds per 100 Square Feet Required to Lower Soil pH

Present pH of soil	Desired pH Value of 4.5		
	Sand	Loam	Clay
4.5	0.0	0.0	0.0
5.0	0.4	1.2	1.4
5.5	0.8	2.4	2.6
6.0	1.2	3.5	3.7
6.5	1.5	4.6	4.8
7.0	1.9	5.8	6.0
7.5	2.3	6.9	7.1

Nitrogen deficiency
Or
Iron deficiency ?



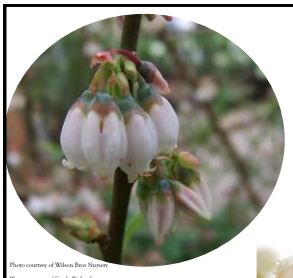


Photo courtesy of Wilson Bros Nursery

Photo courtesy of Sandy Richards

- Self-pollination discouraged
- Cross pollination strongly recommended
- Native sonicating bees best
- Bloom period of 7-20 days

Photo: NCSU.edu

- Ripen 2-3 months after bloom

- Increase in size by ~35% AFTER fruit turn blue
- Sugar content ~ doubles
- Ripe fruit are 85% H_2O
- Don't pick early and put on shelf to ripen

Plant Selection

- **Early season**
  - Duke, Patriot
- **Mid-season**
  - Reka, Northland, Blueray
  - Bluecrop, Bluegold
- **Late mid-season**
  - Chandler, Darrow
- **Late season**
  - Nelson, Jersey
- **Very late**
  - Elliot
- At least 2 varieties
- Highbush + lowbush + half-high

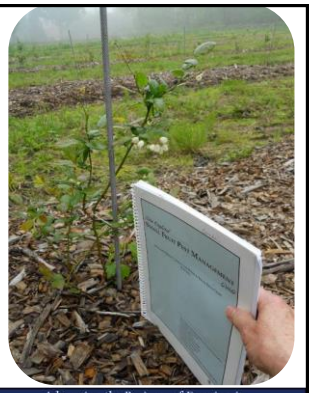
Planting & Care

- Planting time
  - Bare root or container
  - Spring in northeast
- Soak roots before or water immediately
- Root pruning - NO

Planting & Care

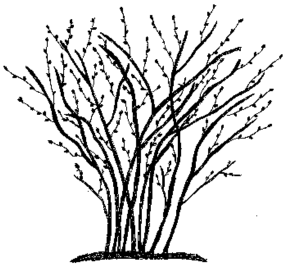
- Apply 4 - 6 inches mulch, flat top
- Between rows
  - mulch, sod

3 years old plant



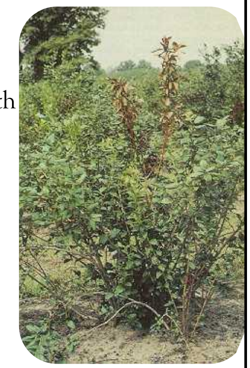
Pruning Blueberries

- Timing
- 1st 2 – 3 years remove
  - Flower buds
  - Dead wood
  - Broken wood
  - Diseased wood
  - Weak wood



Drawing courtesy of OSU

- Year 3 onward
- 2 – 3 canes per year of growth
- No canes older than 6 years
- Remove dead, low, weak canes



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Dead canes

Weak canes

Low canes

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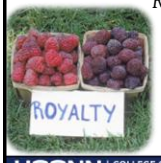
Rejuvenation

Brambles

Rubus

R. idaeus – red and yellow raspberry
R. occidentalis – black raspberry
R. neglectus – purple raspberry
R. fructicosus – blackberries



Other Brambles

- Dewberry: *Rubus trivialis*
  - Trailing habit, related to blackberry

- Boysenberry: *Rubus ursinus x idaeus*
  - Cross between raspberry, blackberry & loganberry

Other Brambles

- Loganberry: *Rubus x loganobaccus*
  - Accidental cross between blackberry & red raspberry

- Tayberry: *Rubus fruticosus x idaeus*
  - Cross between black raspberry & Loganberry

Planting & Care

- Canes are hardy
  - reds to -30^{0}F
  - Others to -10^{0}F
- Self-fruitful
- Full sun

DON'T plant brambles or strawberries where . . .

- Tomatoes, potato, eggplant in past 4-5 years: VerticilliumWilt

Photos courtesy of Oregon State Univ. Extension

Fertility

Avoid potassium chloride fertilizer

University of Connecticut
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Phone : 860-486-4274, Fax : 860-486-4562.

GROWER'S ADDRESS

SAMPLE ID
BASIL 1
LAB ID | RECEIVED | REPORTED
29196 | 04/21/12 | 05/01/12
SALES AGENT

NUTRIENTS EXTRACTED FROM YOUR SOIL (MODIFIED MORGAN EXTRACTABLE)

		BELOW OPTIMUM	OPTIMUM	ABOVE OPTIMUM
pH	6.9			
Calcium	>4000 lbs/acre			
Magnesium	472 lbs/acre			
Phosphorus	73 lbs/acre			
Potassium	>600 lbs/acre			

Element	ppm	Soil Range
Boron (B)	0.40	0.1-2.0
Copper (Cu)	0.20	0.3-8.0
Iron (Fe)	29.10	1.0-40.0
Manganese (Mn)	10.20	3.0-20.0
Zinc (Zn)	2.40	0.1-70.0
Aluminum (Al)	72	10-300

Estimated Total Lead: Low, typical background levels

LIME AND FERTILIZER RECOMMENDATIONS

BRAMBLES
LIMESTONE RECOMMENDATIONS: The target pH for brambles is 6.3. No ground limestone is necessary this year. Retest pH in 2 to 3 years.

FERTILIZER RECOMMENDATIONS: Both soil test **PHOSPHORUS** and **POTASSIUM** are **ABOVE OPTIMUM**. Broadcast in early spring, **0 lbs** of P_2O_5 and **0 lbs** of K_2O per acre.

NITROGEN requirements vary by bramble type. For established plantings, apply **50 to 80** lbs. N/A for fall-bearing primocane varieties, **50 to 60** lbs. N/A for summer bearing reds, and **40 to 45** lbs. N/A for summer bearing black and purple raspberries and thorny blackberries.

Notes:
1) Nitrogen application rates should be increased if mulch is used but decreased after mulch begins to decompose.
2) Broadcast fertilizer in a 2 to 4 foot band over the rows of established plants in early spring.
3) Applications may be split (April and May) for fall bearing primocane varieties or on sandy soils.
4) The recommended rate of fertilizer can be reduced by 50% if it is banded.
5) Apply fertilizer when foliage is dry. Water thoroughly after fertilizing.
6) An application of Solubor (20.5% boron) at a rate of 6 lbs. per acre is suggested but not always essential. Do not apply boron at higher rates or more frequently than once every 3 years as plant injury may result.

If you have any questions call the UConn Soil Nutrient Analysis Lab at (860) 486-4274

Remove Weeds

Planting

- Majority of roots in top 10" of soil
- ~10-20% in next 10"
- Shoot buds develop on roots
- Shoot buds develop at crown

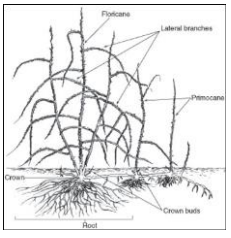


Diagram U of Illinois Extension

Pruning Floricane Fruiting Raspberry

Summer reds

- Tipping
- Timing
- Remove spent fruiting canes, weak canes
- Reduce row width to 1'
- 4-5 canes/linear ft of row

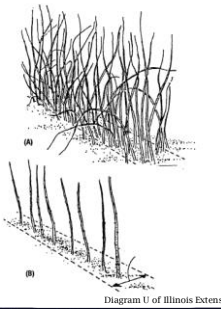


Diagram U of Illinois Extension

Summer Bramble Training Systems

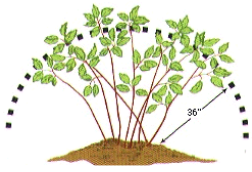
"I" trellis

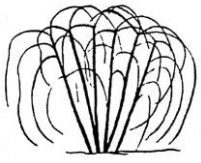
"V" trellis

Photos M. Pritts, Cornell

Pruning Floricane Fruiting Black & Purple Raspberry & Blackberry

- Tipping early summer
  - 3"-4" when canes at the wire

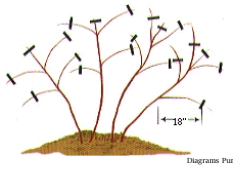




Diagrams Purdue Univ

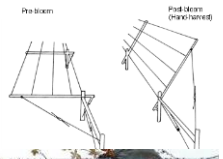
Pruning Floricane Fruiting Black & Purple Raspberry & Blackberry

- Remove spent fruiting canes, weak canes
- Leave 4-8 strong canes/crown
- Winter tipping



Diagrams Purdue Univ

- Stiles shift trellis
  - For semi-erect & trailing blackberries



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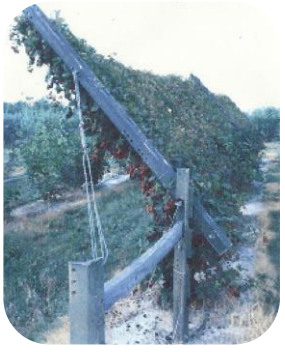

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Fall Fruiting Brambles

aka - Everbearing

- Annual fruit production
- Primocane bearing
- Red & yellow raspberries
- Blackberries

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Fall bearing Brambles

- **Red raspberries**
  - Heritage, Autumn Britton, Caroline, Josephine, Polana, Himbo Top, Nantahala, Polka, Jaclyn, Joan J, Prelude
- **Black raspberries**
  - Niwot
- **Yellow raspberries**
  - Anne, Kiwigold, Fall Gold
- **Blackberries**
  - Prime Jan, Prime Jim, Prime Ark 45, Prime Ark Freedom

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Pruning Fall bearing Brambles

- After harvest, once plants are dormant
- Don't leave long stubs

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Double Cropping

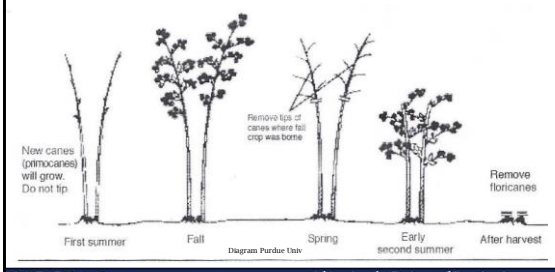


Diagram Purdue Univ

Strawberries

Fragaria ananassa

Photo courtesy of U. of Ill. Extension

Site Selection & Preparation

- Avoid frost pockets

Types of Strawberries

- Alpine, *Fragaria vesca*
  - Red, white, yellow fruit
  - Full sun to partial shade

Photo Rareseeds.com

Types of Strawberries

- June bearers
  - Early season: Chandler, Earliglow, Cavendish, Honeoye, Northeaster, L'amour
  - Mid-season: Allstar, Darselect, Jewel, Seneca, Ovation, Sparkle
  - Late season: AC Valley Sunset, Record
- Everbearers or Day Neutrals
  - Everest, Tribute, Tristar, Seascape, Mara Des Bois, Evie 2

Pollination

- Self-fruitful

www.Bugguide.net

Fertility

University of Connecticut
Department of Plant Science

Soil Nutrient Analysis Laboratory, 6 Sherman Place, Box U-102, Storrs, CT 06269-5102,
Phone : 860-486-4274, Fax : 860-486-4562.

GROWER'S ADDRESS	SAMPLE ID
	FL03: 19 STRAWBERRY
	LAB ID / RECEIVED / REPORTED
	1380 / 04/04/13 / 04/08/13
	SALES AGENT
	DAVE POSTEMSKI

NUTRIENTS EXTRACTED FROM YOUR SOIL (MODIFIED MORGAN EXTRACTABLE)

			BELOW OPTIMUM	OPTIMUM	ABOVE OPTIMUM
pH	5.8				
Calcium	1570	lbs/acre	**********		
Magnesium	201	lbs/acre	**********		
Phosphorus	1	lbs/acre	***		
Potassium	178	lbs/acre	**********		

Element	ppm	Soil Range
Boron (B)	0.10	0.1-2.0
Copper (Cu)	0.20	0.3-8.0
Iron (Fe)	5.30	1.0-40.0
Manganese (Mn)	3.00	3.0-20.0
Zinc (Zn)	0.90	0.1-70.0
Aluminum (Al)	116	10-300

Estimated Total Lead: Low, typical background levels

LIME AND FERTILIZER RECOMMENDATIONS

LIMESTONE: The target pH for strawberries is 6.3. Apply **1175** lbs. of ground limestone per acre. Thoroughly incorporate the recommended amount of limestone into the upper 6 to 8 inches of soil.

Parts of the Plant

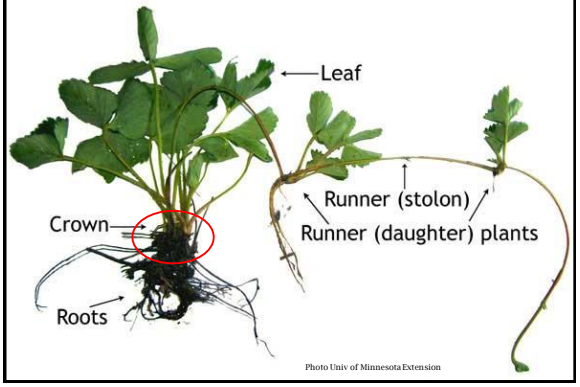


Photo Univ of Minnesota Extension

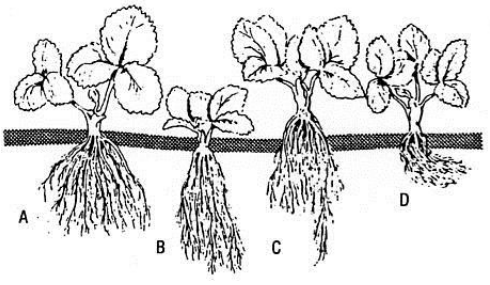
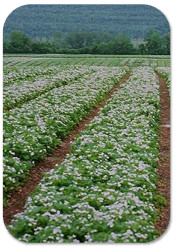


Figure 3. Strawberry planting depth.
A = correct, B = too deep, C = too shallow, D = hole too shallow

Univ of Alabama

Matted Row Planting System



- June Bearers
  - 12"-18" x 3'- 4'
- Day Neutral
  - 6"- 9" x 9" between staggered rows, x 4'
- Flower removal

Photo M. Pritts, Cornell

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Renovation

Photo S. Schloemann

- Mow off the plants
  - Remove diseased leaves
- Thin plants
- Improve sunlight penetration
- 4 - 6# 10-10-10/100' of row after harvest
- Add soil by root crown for root development

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Renovated

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No Renovation Done

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Winter care

- 20^0F crown damage

S. Schloemann

Currants & Gooseberries

Ribes

- *R. sativum*, *R. rubrum* (red)
- *R. petraeum* (white)
- *R. nigrum* (black)
- *R. odoratum* (native)
- *R. hirtellum* (American)
- *R. grossularia* var. *uva-crispa* (European)

Varieties

- Black Currants
  - Consort
  - Titania*
  - Crusader
  - Ben Sarek
- Red Currants
  - Rovada
  - Jonkheer Van Tets
  - Cascade
  - Red Lake
- White Currants
  - Blanca
  - Pink Champagne
- Native Currant
  - Crandall

Varieties

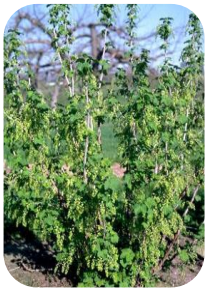
- Red Gooseberries
  - Hinnonmaki Red
  - Tixia
  - Captivator
  - Pixwell
  - Poorman
- Green Gooseberries
  - Invicta

Jostaberry

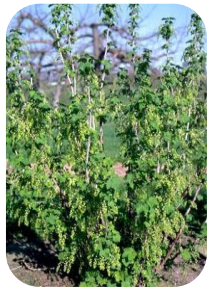
- Cross between gooseberry and black currant
- Fruit similar to gooseberry
- Thornless
- Resistant to White pine blister rust
- Varieties
  - Jostaki, Josta, Jostagrande

Site Selection & Preparation

- Full sun to partial shade
- Well drained soils
- OM at least 3%
- Soil pH 6.0 - 6.5
- Tolerate -22 to -31^{0}F

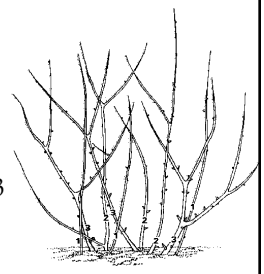


- Fibrous root system
- Raised bed /container option
- Mulch 2"– 4"
- Avoid potassium chloride
- No fruit 1st year
- Harvest in July



Pruning

- Dormant
- Year 1: 6 - 8 canes
- Year 2: 4 – 5 canes
- Year 3: 3 – 4 canes
- Mature plants 9-12 stems
- Prune out all wood over 3 years old



Grapes

Vitis

V. vinifera - European
V. labrusca - American
V. rotundifolia - Muscadine
V. Vinifera cultivars X disease resistant wild American species – French hybrids

Plant Selection

- Table grapes
  - Concord - black
  - Thompson seedless – white*
  - Thomcord – black*
  - Canadice – red*
  - Himrod – white*
  - Reliance – red*
  - Seneca – white
  - Steuben – black

Plant Selection

- Wine: Red
  - Delaware
  - Catawba
  - Frontenac
  - Marquette
  - Chambourcin
  - Cabernet
  - Merlot
- Wine: White
  - Niagara
  - Cayuga White
  - Frontenac Gris
  - Seyval Blanc
  - Vidal Blanc
  - Edelweiss
  - Aurora

The Plant

- Deep roots
- 3-in-1 buds
- Cordon, shoots, tendril

Planting & Care

- pH 5.5 – 7.0
  - American: 5.5-6.0
  - French/European: 6.5-7.0
  - French/American: 6.0-6.5
- No fertilizer at planting
- Grow tubes
- Remove flower buds 1st year

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Pruning & Training

- Stake and tie 1st year
- Remove lateral shoots on trunk
- Choose training system

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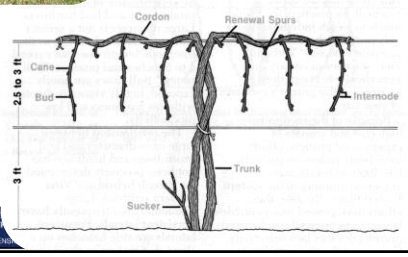
Bilateral Cordon System



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Pruning & Training

- Balanced pruning
  - 30 + 10 system
- Remove 70-90% of last year's wood

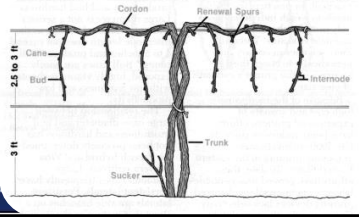

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Photo S. Schloemann

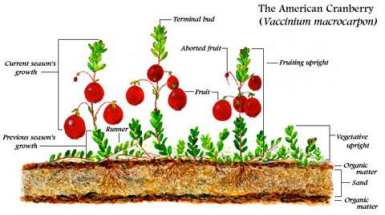
Cranberry

Vaccinium macrocarpon

Photo courtesy of Marvin Pritts

- Native to northeast
- Heath family
- Wetland plant but…
- Trailing plant
- Rhizomes grow couple feet/yr
- Uprights bear fruit

- Plant fall or early spring
- pH 4.0-5.0
- Shallow fibrous root system



- Varieties
  - Early Black - MA
  - Howes - MA
  - McFarlin - MA
  - Stevens - NJ
  - Ben Lear - WI
  - Searles - WI

Photo Cranberries.org

Photos courtesy of UMaine

- Harvest in fall
  - Plants 2-3 years old
  - Dry, wet
- Add thin layer of sand after harvest every 2-3 years
- Mulch late fall
- Prune runners not uprights

Elderberry

Sambucus nigra

- Denmark Series
  - Samdal, Samyl
- NY Series
  - Adams No. 1 &s No. 2, York
- Nova Scotia series
  - Johns, Kent, Nova, Scotia, Victoria
- Missouri series
  - Bob Gordon, Wyldewood

- Hardy to zone 4, some lower
- Soil pH 6.0 -6.8
- Shallow rooted
  - Don't allow to dry out year 1
- Weed management is critical
- Flower in June

Ripen in August-Sept

Prune in dormant season

Photo: Barefootgedne.com

- No canes over 3 years
- Thin to 6-8 canes
- Prune all canes to the ground

Small Fruit IPM

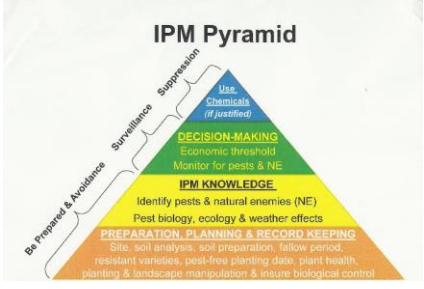


Diagram: Donn Johnson, U. of Arkansas

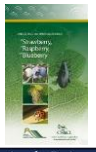
Principles of Integrated Pest Management

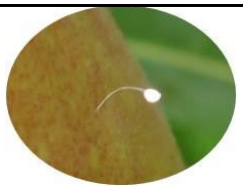
- 97% of insects that you see in your yard are beneficial or innocent bystanders and are not damaging plants.
- Plants can tolerate some damage from pests.
- Beneficials do not eat all pests, instead, pest and beneficial arthropod populations are kept in a balance.

Syrphid larvae preying on an aphid.

IPM Tools You Will Need

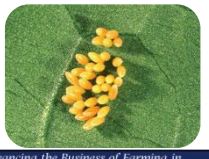
- Understanding of key pests & diseases
- Magnifier
- Picture guides
- Method for keeping track of observations
- Knife
- Traps and lures





Lacewing

Lady beetle



Abiotic Disorders

- Sunburn
- Hail
- Nutritional
- Chemical

Birds

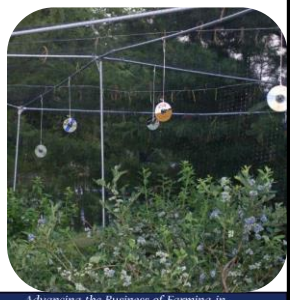
- Biggest problem in blueberries
- 37 species of birds are attracted to blueberries
- No threshold

IPM Management: Birds

- Auditory scare tactics

IPM Management: Birds

- Auditory scare tactics
- Visual scare tactics



Physical Barriers

Photo: River Valley Fencing

Deer and Rodents

- Girdle canes
- Eat buds, foliage, fruit
- IPM management
  - Exclusion
  - Repellents
  - Predators
  - Traps

Spotted Wing Drosophila

Drosophila suzukii

- Feed on wide range of fruit
- Female ID
  - Serrated oviposter
  - Egg laying: over 300 eggs/female
- Male ID
  - Wings

Photos courtesy of Illinois.IPM.edu

Spotted Wing Drosophila IPM

- Many alternate hosts
- 8-12 generations/year

Spotted Wing Drosophila IPM

- Sanitation
- Traps
- Insecticides
- Ongoing research

Brown Marmorated Stink Bug

Life Cycle

- Overwinters as adults
- Female lays up to 250 eggs into the summer
  - Clustered 25-30

Damage

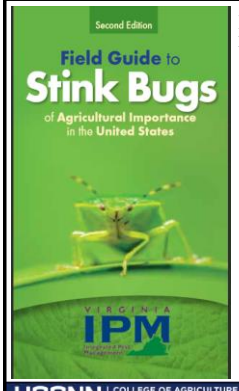
- Suck juices from fruit
- Inject yeast, bacteria

Photo: M. Raupp, UMD

Photo: stopbmsb.org

Life Cycle

- 5 nymphal stages
- 1-2 generations/year



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BMSB
Halyomorpha halys
Photo: Bugguide.net

Rough Stink Bug
Brochymena quadripustulata,
Photo: Bugguide.net

Look-a-Likes

Spined soldier bug
Podisus maculiventris
Photo: Marlin Rice

Brown Stink Bug
Euschistus servus
Photo: Bugguide.net

Dusky Stink Bug
Euschistus tristigmus
Photo: Bugguide.net

Monitoring

Tedder traps + pheromone lure

- Not for trapping out
- Modify top

Placement

- Border vegetation
- Orchard/vineyard border row
- Orchard/vineyard center

Threshold

- Established for apples only so far

Photo: M. Concklin

Management

- Insecticides along border
- Insecticides alternate middles
- Insecticides whole block
- Biological control
  - *Trissolcus japonicas*
  - Other parasitoids

Photo: stopbmsb.org

Cane Borers

- Raspberry Cane Borer, *Oberea bimaculata*
- Red Necked Cane Borer, *Agrilus ruficollis*
- Currant Cane Borer, *Synanthedon tipuliformis*

Raspberry Cane Borer

- 2 year life cycle
- 2 rings of punctures ½ " apart, 6" below growing tip
- Hatch July
- Larvae burrows down cane to crown first year
- Second year feed on crowns
- Adults emerge following later spring-early summer

Raspberry Cane Borer IPM

- Management
  - Remove wilted tip below the rings - destroy
  - No biological control

Rednecked Cane Borer

- Adults feed on foliage through summer
- Eggs inserted 10" from ground in summer
- Larvae tunnel into cane in fall
- Swelling
- Adults emerge following late spring
- Cane weakened

Rednecked Cane Borer IPM

- Management
  - Sanitation: remove infested canes before June 1
  - Sanitation: proper pruning and disposal of old canes
  - No biological control

Mummy Berry

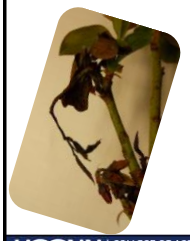
Monilinia vaccinii-corymbosi

Cornell University

- Fungus overwinters in mummified berries
- Blooming forsythia
- Spring infections
- Primary & secondary stages
- Blueray highly susceptible

Photo MSU

Disease cycle



- Fungus overwinters in mummified fruit
- Cool rainy weather, 50-62 degrees F
- Spring: spores released, move by bees, wind, rain
- 6-12 hours leaf wetness at 59 degrees
- Infect young tissue, then to petioles

Disease cycle

- Secondary stage – spores move to open flowers
- Fruit infected
- Infected fruit mummify, drop to ground

Mummy Berry IPM

- Management
  - Forsythia & mummy cups
  - Sanitation
  - Avoid susceptible varieties
    - Bluecrop, Blueray, Collins, Earliblue, Weymouth, Jersey, Berkley
  - Cover mummies 1" mulch
  - Fungicides

Leather Rot *Phytophthora cactorum*
Red Stele *Phytophthora fragariae*
Phytophthora spp; Phytophthora cinnamomi

- Soil borne
- Causes fruit & crown rot
- Rain splashed from soil to fruit
- Management
  - Avoid fruit - soil contact
  - Avoid water puddling
  - Mulch plants
  - Raised beds

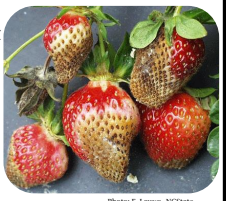


Photo: F. Louws, NCState

Red Stele Life Cycle

- Wet soils → fungal spores released
- Favor soil temps of 44-60 degrees F
- Infect root tip
- Fungus grows into the root

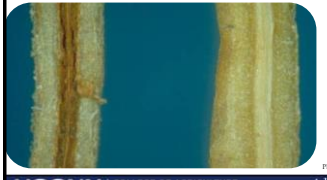


Photo Ontario Gov.

Cultural management

- Plant resistant varieties
  AC Wendy, Annapolis, Early Glow, Cavendish, Allstar, Flavorfest, etc.
- Certified disease-free plants
- Good soil drainage
- Raised beds
- Sanitation: remove all of the infected plants' parts

Photo courtesy of Marvin Pritts

Gray Mold – Bunch Rot

Botrytis cinerea

- Wet cool weather, high RH
- Stone fruit, berries, grapes
- Life cycle
  - OW in infected foliage, twigs, soil organic matter
  - Moves to healthy tissue, flowers, fruit
  - Picked fruit
  - Moves on new plants, cuttings

Cultural Management

- Keep fruit off soil
- Promote good air circulation
- Avoid too much nitrogen
- Avoid overhead watering
- Plant disease free plants
- Sanitation
- No 2 fruit touching

Grape Berry Moth

Endopiza vitana

- 2 - 3 generations per year
- OW in debris, woodlots as pupae
- Adults emerge spring
- 1st generation lay eggs on blossom clusters, stems
- Larvae feed on flowers, fruit clusters
- 2nd generation lays eggs on berries
- Larvae feed internally
- 3rd generation in late July

Grape Berry Moth IPM

- Management
  - Remove wild grapes
  - Look for OW larvae
  - Monitor with GBM traps
  - Monitor clusters – threshold ~3% infested clusters
  - Sanitation: rake & dispose of leaves

Grape Berry Moth IPM

- Management
  - Insecticides
  - Kaolin clay repellent
  - Biological control minimal with *Trichogramma minutum*

Black Rot

Guignardia bidwellii

- Life cycle
  - Over-winter in mummies
  - Spring rains release spores
  - Bud break – veraison
  - Young plant tissue more susceptible

Duration of continuous leaf wetness necessary for infection by *Guignardia bidwellii* at different temperatures

Temperature	Hrs of leaf wetness
45	No infection
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

- Period of susceptibility
  - Foliage until finish expansion
  - Fruit 3-5 weeks after bloom
  - *V. vinifera* most susceptible
- Symptoms
  - Fruit symptoms appear within 2 weeks
  - Infections near veraison show symptoms 3-5 weeks later
  - Foliage: lesion center becomes reddish brown

Black Rot IPM

- Management
  - Sanitation – remove & destroy all mummies
  - Mulch
  - Good air circulation
  - Leaf removal during season
  - Fungicides

Questions?

Photo credits, unless otherwise specified:
Mary Concklin