

Producing Fruit for the Home

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Where to start?

- Fruit plants that fit into to small spaces
 - Apple ... on dwarfing rootstocks
 - Most traditional and local garden centers do not identify specific rootstock "Dwarf", "Semi Dwarf"
 - Eventual tree size within Dwarf and Semi Dwarf is large

Rootstocks	Nursery ID	Eventual Height	Tree Spacing	
			Between Trees	Between Rows
M.27 or P.22	Dwarf	6	5	10
M.9	Dwarf	8	8	12
M.26	Dwarf	16	10	16
M.7	Semi Dwarf	18	14	22
MM.106 or 111	Semi Dwarf	20	16	22

Where to start?

- Select desired fruit which will grow in your area.
- Determine how much space you have available.
- Select varieties which are easiest to grow.
 - Disease or insect resistant varieties to reduce pest pressures.
 - Assess soil / site conditions
 - Full sun VS shade or partial
 - Soil internal drainage
 - Weed competition (lawns are too competitive)

Where to start?

- Fruit plants that fit into to small spaces
 - Cherry - Sour

Varieties	Rootstocks	Eventual Height	Tree Spacing	
			Between Trees	Between Rows
Northstar	Mahaleb	10	8	12
Montmorency	Gi.5 or 6	12	10	12
Montmorency	Mahaleb	12	10	14
Montmorency	Mazzard	14	12	16
Balaton	Mahaleb	14	12	16

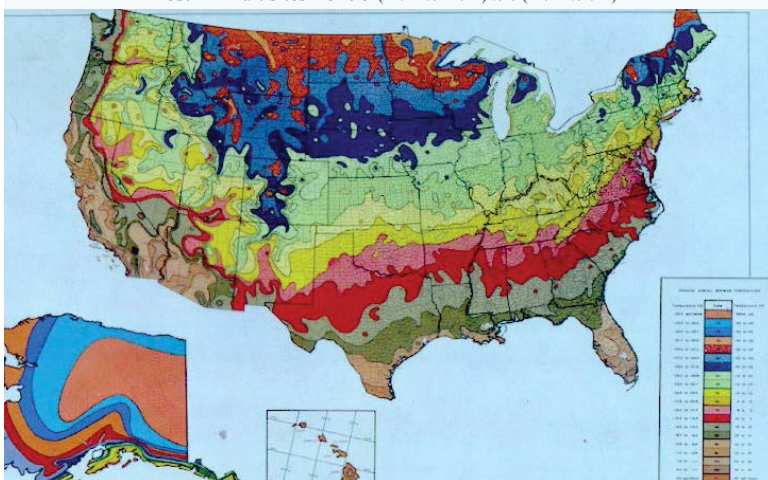
- Cherry - Sweet

Rootstocks	Nursery ID	Eventual Height	Tree Spacing	
			Between Trees	Between Rows
Gi.5	Dwarf	12	12	16
Gi.6	Dwarf	14	14	16
Mahaleb	Semi Dwarf	20	14	16
Mazzard	Semi Dwarf	24	16	20

Average Annual Minimum Temperatures

(USDA Plant Hardiness Zone Map)

Most MI fruit sites Zone 5 (-20°F to -10°F) to 6 (-10°F to 0°F)



Where to start?

- Fruit plants that fit into to small spaces
 - Peach, Nectarine, Apricot and Plums
 - Can generally plant at a spacing of 10 ft X 15 ft*
 - * If trained to open center or vase shape
 - Closer spacing, needs to be trained in Christmas Tree form (Vertical Axe).



Open Center



Vertical Axe

Fruit (apple) trees were once grown in an extensive system when land and labor was inexpensive.



MSU Horticulture Gardens

Today orchards are made up of small trees which makes them efficient, perfect for the home orchard too

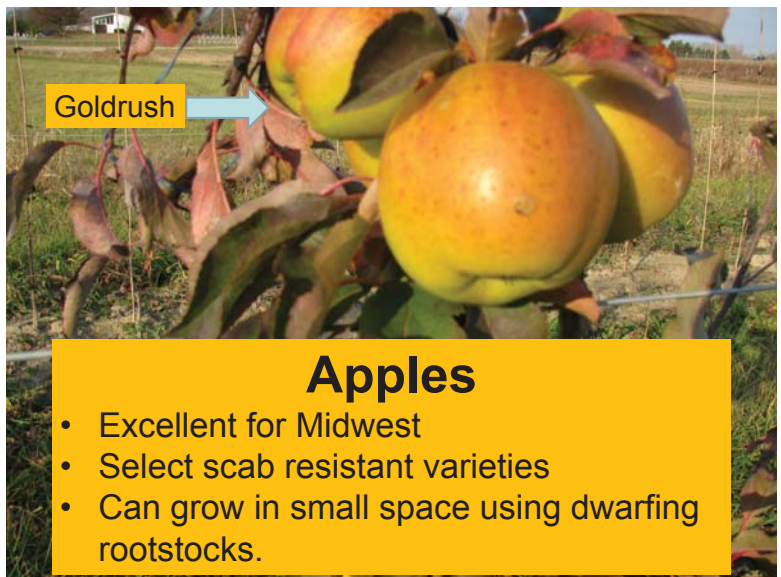


Tree Fruit

Consider Fruits that require the least space and the least work to maintain

- Small Fruit

- Blueberries (need acid soil)
- Raspberries (fungicides for fruit rot if not grown under tunnels)
- Strawberries (more work and TLC)
- Grapes
 - Table grapes (seedless) for fresh
 - Reliance, Marquis, etc.
 - Juice grapes – Concord / Niagara
 - Reliance, Marquis, etc.
 - Wine grapes –
 - Frontenac, LaCrescent, Chambourcin, Marquette



Goldrush

Apples

- Excellent for Midwest
- Select scab resistant varieties
- Can grow in small space using dwarfing rootstocks.



- Scab Resistants for Organic/Home
1. Start with Scab resistant varieties
 - 50-60 % of sprays to control scab
 - Cu, Lime/Sulfur, Sulfur
 - “Club Varieties”... not accessible to hobby gardeners!!
 - Sweet Tango, Jazz and others
 - Improved strains
 - Limb sports

Heirloom Varieties; with known disease resistance (FB & Scab) In 1892 735 apple varieties; today fewer than 50.

Variety	FB	SCAB	Variety	FB	SCAB
Arkansaw	r	r	McShay	ms	vr (9)
Bramley's Seedling	r	r (6)	Moira		vr (10)
Brown Russet		r (6)	Mother		r (6)
Chehalis	mr	r	Murray	r (10)	vr (10)
Dayton	mr	vr (9)	Richelieu		vr (13)
Enterprise	r (10)	vr (10)	Rouville		vr (13)
Golden Russet	ms	r	Sir Prize	ms (3)	vr (6)
Hudsons Golden Gem	r	r (6)	Stirling		r (6)
Jeffers	r	r	Trent	r (10)	vr (10)
King David	ms	r	Tydemans Early		r (6)
Wolf River	vs (4)	r (6)	Williams Pride	r (3)	vr (9)

<http://attra.ncat.gov/attra-subjects.htm#Appendix2>
 Organic and Low-Spray Apple Production, Horticulture Production Guide
 By R. Earles, G. Ames, R. Balasubrahmanyam, and H. Born
 NCAT Agriculture Specialists

Gala Strains

Galaxy CHES 9-13-07

Ultrared CHES 9-13-07

Improved CHES 9-13-07

Imperial CHES 9-13-07

Royal CHES 9-13-07

Phil Schwallier

Crimson Crisp (formerly COOP 39)

Scab resistant but not to Cedar Apple Rust

Terms:

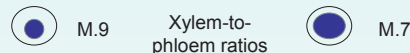
- Rootstock – the root system *genotype* of a grafted or bud
- Scion – the canopy *genotype* of a grafted or budded tree
- **Why:.....**
- A. Propagate desirable fruit cultivars (hard to root)
- B. Gain uniformity, precocity in fruiting (vs. seedlings)
- C. Control tree size (vigor)
- D. Adapt to local soil conditions (pH, texture, drainage, drought, etc.)
- E. Tolerate soil pests (insects, diseases, nematodes)
- F. Adapt to environmental stresses (cold hardiness, summer heat)



Development of new apple rootstocks depends on breeding and subsequent long-term field testing

Developing improved rootstocks (characteristics and precautions)

- a. Must root and sucker readily in stool bed
- b. Influence great range in vigor
- c. Yields influenced by precocity + density (smaller trees) = light interception, branch angles, fruit/shoot ratio
- d. Support required for M.9, Mark, M.26, etc. due to precocity, brittle roots, function of ratio of xylem to phloem tissue, and change in **yield efficiency** and **harvest index** (more fruit per tree size as measured by trunk diameter or tree weight, respectively)



Rootstocks for Tree Fruit Crops

- Apple growers have had an arsenal of **clonal** rootstocks to select from that were developed through breeding in England (East Malling).
- All other crops have tried to mimic the history and success in developing apple rootstocks.
- Many trees are still propagated on **seedling** rootstocks; peach, apricot, many plums, some cherry



Is Support Necessary????

- Support is necessary due to weight of fruit on small branches
- Canopy volume is lost
- Crop weight can cause load to topple tree / brittle root system



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Clonal Apple Rootstocks for Michigan

Malling Series

- M.9 (EMLA.9, T-or NAKB-337, Pajam 2, RN- or Nic-29)
- M.26 (EMLA.26)
- M.7 (EMLA.7)
- MM.106 (EMLA.106)
- M.111 (EMLA.111)

Garden Centers list them as "Dwarf", "Semi Dwarf", "Vigorous"

Budagovsky Series

- Bud.9 (B.9)****
- Bud.118 (B.118)

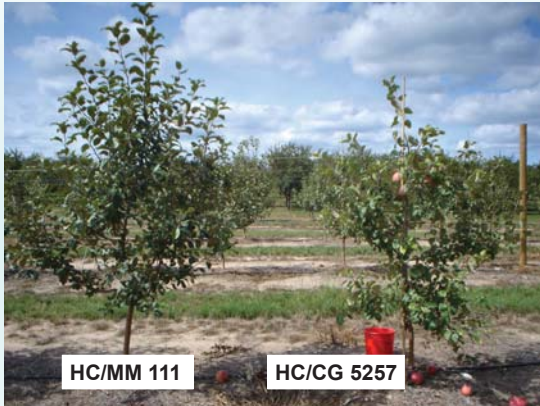
Cornell-Geneva Series

- G.11 G.16
- G.30* G.41
- G.935 G.202
- G.210 G.214
- G.222 G.890

Cropping, especially on precocious rootstocks, eliminates dominance of Central Leader

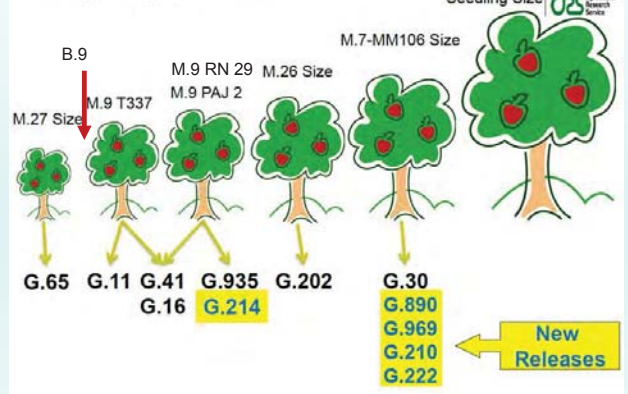


Rootstocks can dwarf and improve precocity; Honeycrisp rootstock trial TC



29

Released GENEVA® Apple Rootstocks Arranged by Tree Size



32

Dwarfing Apple Stocks: Low-Vigor M.9 Clones

M.9 NAKB 337 (Selected in Holland, virus-free)

- 30-35% of seedling vigor
- + Precocious, large fruit, productive
- + Tolerant of many soils, with the exception of light soils
- - In Michigan, tends to be inferior in performance to other M.9 clones
- - Transplants slowly, especially if poorly treated in shipment/storage
- - Highly susceptible to fireblight
- - Moderately cold sensitive
- - Requires irrigation and support
- - Dominant M.9 clone grown globally

30



Gala / B.9 after 9 yrs



Gala / NAKB.337 after 9 yrs

33

Other Commercial Dwarfing Stocks

Budagovsky 9 (B.9 or Bud.9) (developed in Russia)

- 25-35% of seedling vigor
- + Adapted to a wide range of soil types
- + Precocious and productive
- + Consistent cropping across varieties and years
- + Confers resistance to fireblight to the scion (even though the rootstock is susceptible)
- + Resistant to Phytophthora, mildew, and apple scab
- + Excellent cold hardiness
- + No license protection (not patented)
- - Fruiting too early may cause "runting" of tree
- - Requires irrigation and support

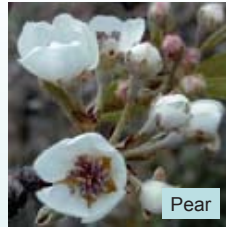
31

Apple tree spacing and rootstocks

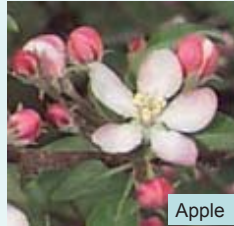
- <http://extension.umass.edu/fruitadvisor/fact-sheets/tree-spacing-calculator>
- Developed for commercial fruit growers but helps students and hobbyists understand the factors in the decision making process.

Pears

- Two Types: European, Asian
- Wider geographic range: generally best adapted to dry, hot climates. Less cold hardy than apple.
- Differ from apple:
 - Grit Cells in fruit
 - Pear has raceme inflorescence & apple has cyme inflorescence.... King (center) flower blooms last in pears; first in apple.



Pear



Apple

Pears in 'Fan'/ Palmete System



Pears

- Pears
 - Harrow Sweet and Pollinizer
 - Plant Fireblight tolerant varieties
1. Harrow Sweet
 2. Harrow Delight
 3. Harrow Crisp
 4. Blake's Pride
 5. Shenandoah

Traditional Modified Central Leader system in commercial orchards



HD System in France



Asian pears (*Pyrus pyrifolia*)



Chojuro

Hosui

Nijisseiki

Shinko

Easier for hobbyists than commercial fruit growers... lots of TLC

Seedling Rootstocks

European pears

- Bartlett – seeds from cannery run fruits from older trees in California is common.
- *P. serotina* and *P. ussurensis* were used somewhat on the West Coast.
- *P. calleryana* used somewhat in southern regions

Asian pears

- *P. betulifolia*, appears most suited based on observations in the Northeast. Produces a vigorous, well anchored, drought tolerant tree. Recommended spacing 12 feet (in-row) by 20 feet between rows.
- OHF 97 also appears suited for Asian pears. Trees are full size, hardy and productive.

Clonal Pear Rootstocks

Quince A -G (*Cydonia oblonga*) 'Provence'
Common in France. Susceptible to cold and fireblight. Compatible with Anjou and Comice, but not Bartlett, Bosc, WinterNellis, & Seckel.

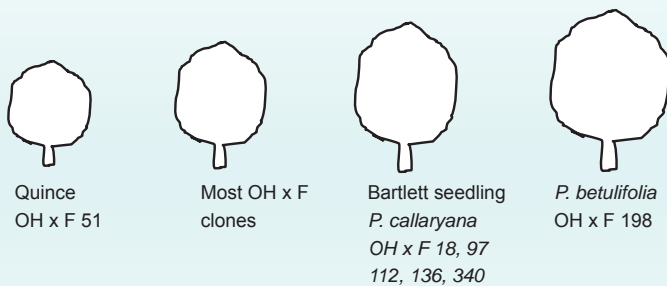
- Only truly dwarf stocks for Pears
- Used in Europe
- Susceptible to Fireblight
- Susceptible to winter cold... likely around 5-10 degrees F is threshold

Sweet Cherry

- Challenge to grow by hobbyists.
 - Diseases (Bacterial Canker, Brown Rot)
 - Fruit cracking (grow crack resistant varieties; Ulster, Gold, etc.).
 - Japanese Beetles
 - Blooms early
 - Care in pruning
 - Pollinizer varieties needed
- Requires space of at least 140 sq ft.
 - Dwarfing rootstocks available... Gisela 3, 5 and 6... makes a tree smaller but not like apples.

Relative Effect of Rootstocks on Pear Tree Size

(Adapted from: Westwood, Temperate Zone Pomology)

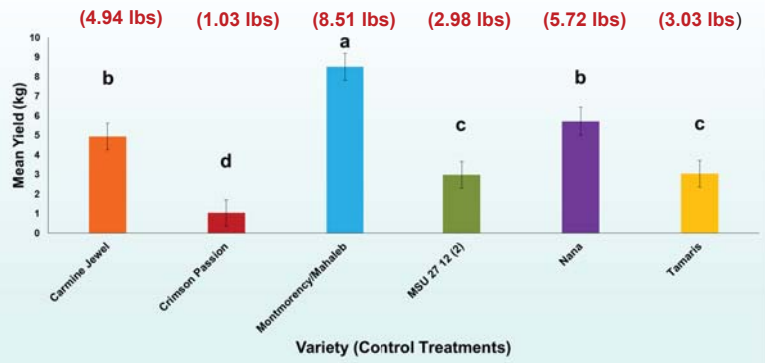


Sour Cherries

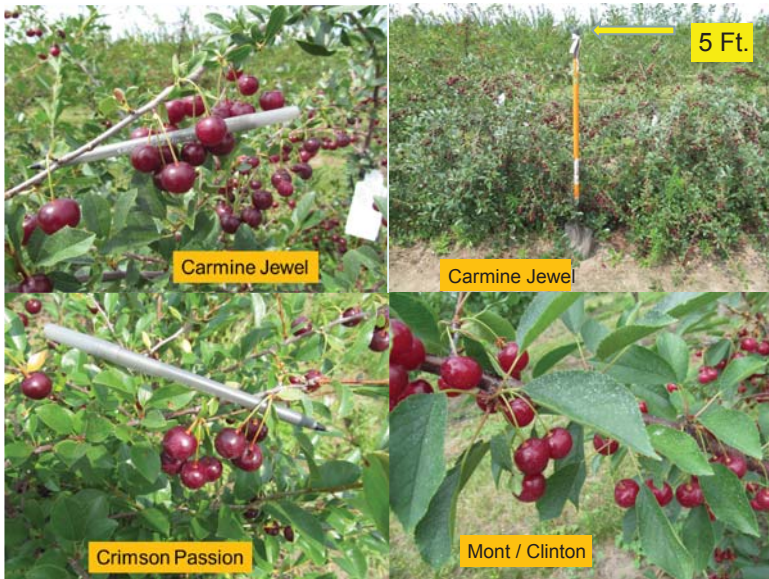
- Low maintenance
- More cold hardy
- No bacterial canker
- Only leaf spot needs controlled
- Smaller trees; need less space
 - 50 sq ft.
- Pollinizer varieties not needed



Univ. of Saskatchewan, Bush Varieties
2013



Yield of 6 tart cherry varieties 4th season; No Canopy or root pruning treatments



Plums



Two Types:

Prune plums: *Prunus domestica*

Japanese plums: *Prunus salicina*

U of Sask Varieties

- P.Fruticosa X Cerasus hybrids
- Bush... 8-9 feet tall max.
- Tissue cultured = no rootstock
- Can take between -20 to -40 F winter cold
- Check out Gardens Alive web/catalog nursery.
 - Exclusive rights to many of the series sold in the U.S.
 - http://www.gardensalive.com/?p=0161278&utm_medium=cpc&utm_source=google&gclid=CM3J-8jRyMMCFYY_aQodmasA5w



European plum, *P. domestica* (commercial varieties) and Japanese plum, *P. salicina*

PLUM



European and Japanese Plums

European: *P. domestica*

- Complex hybrid over 2000 yrs from Europe
- Can grow in cool humid climates
- Prune plums D'Agen or French prune.
 - High sugar and don't ferment when dried with pit
- Some prune plums do not achieve high sugars needed for drying without the pit ("Stanley")
- Mostly for processing but some fresh like Victoria ("President"), Green Gage, Yellow Egg, etc.
- Generally don't require pollinizer variety nearby
- Easier to grow in Midwest

Japanese: *P. Salicina*

- Originated in China
- Prefers warm and dry climate
- Most CA varieties are large, round to oval shaped.
- Most require pollinizer
- Many new varieties that are hard, ship well, colorful, small pit.
- Challenge to grow in Midwest

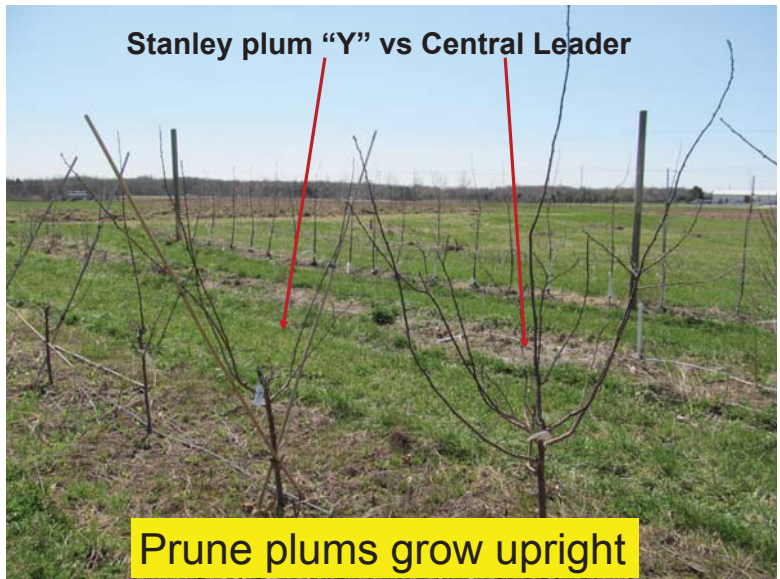
Prune plums for Fresh Harvest and Mktng



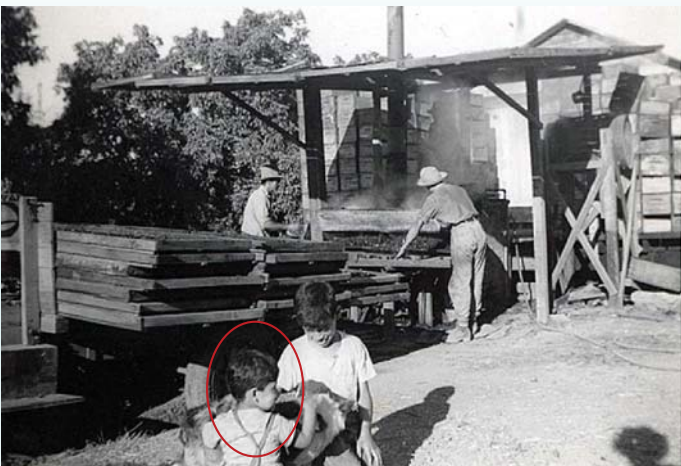
Plum

- Most Japanese plums are trained open center and most Domestic plums are trained to Central or Modified Central Leader systems
- Pests of plum same as other stone fruit including brown rot fungus. Usually worse on Japanese plums than Domestica.
- Sharka or Plum Pox found in Europe is a virus problem that is heavily monitored and quarantined here in America

Stanley plum "Y" vs Central Leader



Prunes: Drying; Archive photo, Perry Family, ~ 1950



Prunus domestica (European plums): most widely cultivated species.

1. Prunes: purple-blue, high sugar for drying
2. Green Gage: round, green to yellow, good fresh, dried
3. Yellow Egg: small group used for canning
4. Lombard: large, round red or pink, for fresh eating

(pollinizers needed)

Mainstays:

Stanley and Shiro (pollinizer)

Prunes (*P. domestica*)



P. persica (commercial varieties),

PEACH AND NECTARINES

Prunus salicina (Japanese plums): probably originated in China, most for fresh eating.

- differences from *P. domestica* include rough bark, and mostly conical or heart-shaped fruit with pointed apex.
- 'Burbank', 'El Dorado', 'Santa Rosa', 'Shiro'
- less hardy as a group than *P. domestica*
- less resistant to Brown Rot than *P. domestica*

Other cultivated species: *P. americana*, *P. munsoniana*, *P. besseyi*, *P. maritima*

Peach and Nectarine

- Originated in China (not Persia)
- Varieties vary in chill hour requirements
- Challenge to grow for hobbyists
- Regional specificity regarding varietal adaptation
 - Varieties grown in one country or region are not grown in others
 - Most Varieties in CA not advisable for Midwest
 - Many breeding programs develop varieties for local and regional production
 - Site specific and tied to local market demands
 - **“Free-stone”** varieties produced and sold for local fresh mkts due to shipping and handling problems
 - Processing varieties are **“cling-stone”** varieties

Black Ice

Black Ice and Toka (pollinizer)
P. Salacina X *Besseyi*
Univ of Wisconsin, Riverfalls, WI..... Cold hardy
<http://blog.lib.umn.edu/efans/ygnews/2011/08/post-16.html>



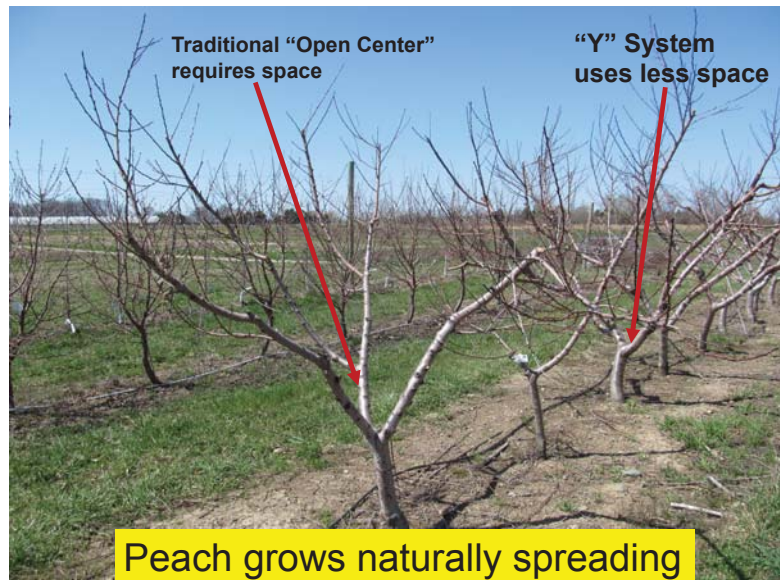
Image by breeder; Brian Smith, UWRF

Peach and Nectarine

- **“Free-stone”** varieties flesh separates from pit during ripening compared to “clings” which remain firm when ripe with flesh attached to pit.
- Constant renewal of varieties for regions due to nature of short lived orchards/trees.
- CA has over 100 nectarine varieties
- Most new variety development has been for fresh harvest Free-stone varieties.
- Michigan mainly relies on “Babygold 5” mainly for Gerbers in Fremont

Peach and Nectarine

- Self-fertile and do not need pollenizer varieties
- Nectarines are peaches with single recessive gene for lack of pubescence on the skin.
- The above genetic trait also makes nectarines more susceptible to disease pests.
- White, yellow and red fleshed peaches exist
- Flat peaches (Peentoo) have a small market in Europe of low acid sweet fruit
- Flowers and fruit born on one year-old shoots

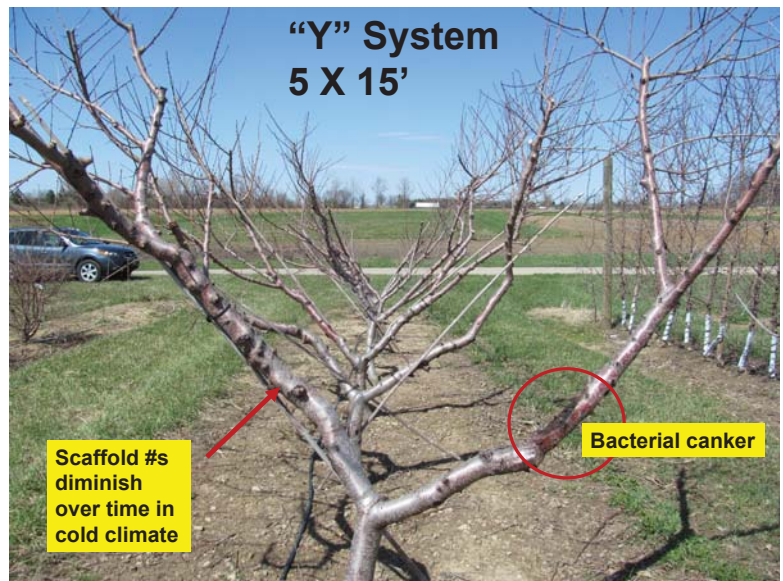


Peach and Nectarine

- Primary diseases include;
 - Brown rot caused by *Monolinia fruticosa*
 - Bacterial canker, *Pseudomonas syringae*
 - Peach leaf curl, *Taphrina deformans*



Associated with cool wet spring, early summer conditions



Peach and Nectarine

- Trees live less than 20 years in mild climates and 10-14 years in colder climates like Midwest
- Trees are generally grown in open center systems with variants of the system such as the Y and Vertical V for HD
- Severely pruned to insure adequate lengths of annual wood where fruit is produced.
- Generally hand thinned, but new string thinners becoming more popular



Apricots, *P. armeniaca* (commercial varieties)

APRICOT



Apricot

- Cold hardy, especially Siberian Apricots. Break bud with warm temperatures early
- Commercially produced in climates avoiding spring frosts.
- Warm dry climates to avoid disease pressures
- Regional specificity regarding varietal adaptation
 - Varieties grown in one country or region are not grown in others
 - Varieties in CA not advisable for Michigan
 - Site specific and tied to local market demands
 - Produced and sold for local fresh mkts due to shipping and handling problems

Apricot

- Most varieties are self fertile
- Pruning and Training;
 - Mostly open center system
 - Fruit born on 1 yr old shoots and short lived spurs
 - Thinning accomplished by regular / severe pruning like peach
- Processing varieties
 - Tilton for canning and dry (CA)
 - Turkey, largest producer has their own varieties

Apricot

- Pests
 - Apricot scab caused by bacterial spot
 - Brown rot, *Monolinia fruticosa*



Blossom blight



Fruit rot approaching harvest

Pollination Principles

- Fruit trees have a requirement for providing a mix of varieties in planning a planting to help provide a source of pollen for cross pollination.
- Pollination is the transfer of pollen from the male part of the flower to the female part of the flower.

Self-fruitful

- Some types of fruit trees maybe pollinated with their own pollen and are considered self-fruitful or self-pollinating.
- Some varieties and species have no such requirement as they are self fruitful.
 - **Sour Cherry, Peach, Nectarine, Apricot**

74

Pollination Principles: Self-unfruitful

- Other types of trees require pollen from a different variety of the same type of tree and are considered self-unfruitful.
- The transfer of pollen from one variety to a different variety of the same type of tree is called crosspollination.
- Cross-pollination is essential for
 - **apples, pears, most sweet cherries, and most Japanese plums.**
- Cross-pollination is not essential, but does improve the number of fruit that form on apricots, European plums/prunes.
- Pollen is primarily transferred by honeybees

75

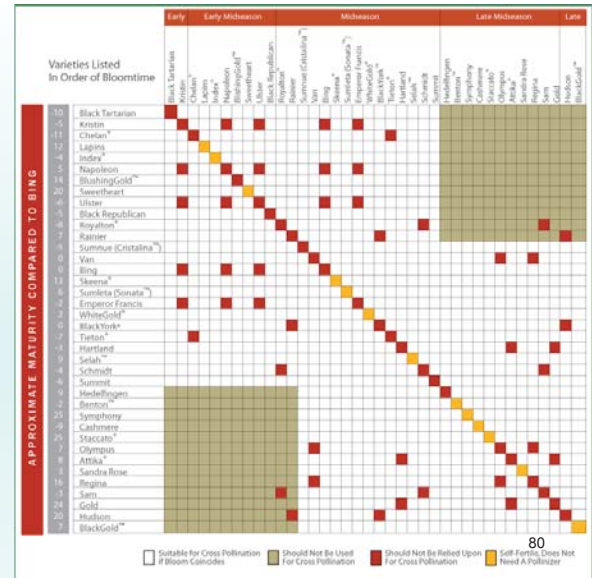
Where to start?

- Determine if fruit needs a pollinizer variety.
- Needed.....order and plant 2-3 diff varieties
 - Apple (crab apples will suffice)
 - Sweet cherry
 - Pears
 - Japanese Plums ... Ozark Premier, Santa Rosa, Satsuma, etc
- Not needed.....
 - Peach, Nectarine, Sour Cherry, Blueberry, Grape, Apricot, Plums (Prune plums like Stanley, etc)

Considerations for selecting pollinizers

1. They should be cross compatible with the main varieties being grown,
2. Form a large amount of flowers annually that bloom simultaneously with the primary variety,
3. While crab apple fruits are largely useless, they provide outstanding cross compatibility for many apple varieties,
 1. Profuse blossoms and abundant pollen and they are often interplanted on dwarfing apple rootstocks into planting.
4. Distance is best if pollinizers are within **90** feet of the variety intended.

Willow Drive Nursery



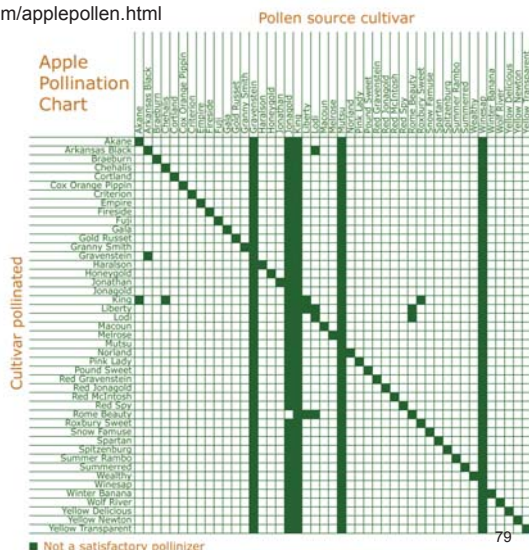
Other considerations

- Bees work best when temperatures above 65°F.
- Cool weather, rain or winds may prevent bees from leaving their hives.
- Most pesticides are toxic to bees and should not be used during bloom time.

Where to start?

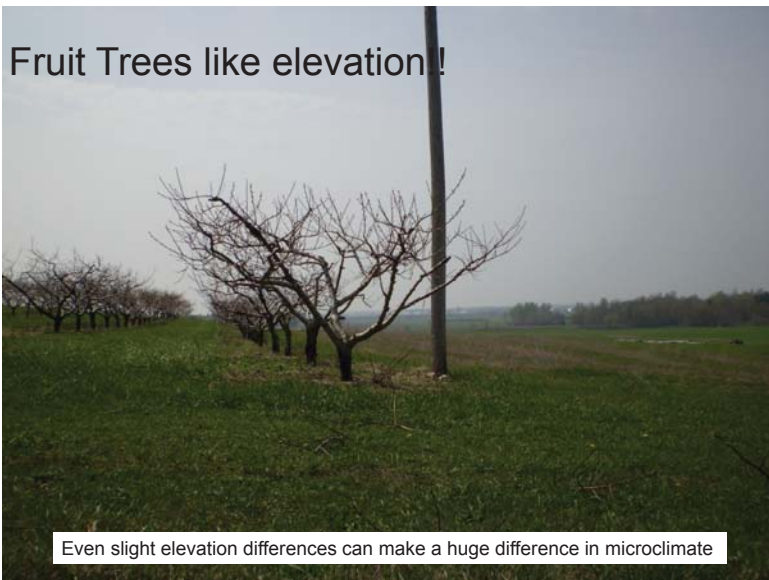
- Purchase from reputable garden centers or nurseries (example of 2 who sell to wholesale and small lots).
 - <http://www.starkbros.com>
 - <http://www.hilltopfruittrees.com/> (larger quantity)
 - <http://www.gardensalive.com>
- Can purchase as bare-rooted plants (less expensive) or many local garden centers sell in containers or B&B.

<http://www.fruit-tree.com/applepollen.html>



Site Preparation

Fruit Trees like elevation!



Even slight elevation differences can make a huge difference in microclimate

Tree health and performance affected by soil depth and maladies



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86

Get to know your soils



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84

Flooding



Flooding in winter or cool temperatures when tree growth is at rest is not harmful, depending on length of time.

These almonds in California were flooded for 40 days and still produced a normal crop.

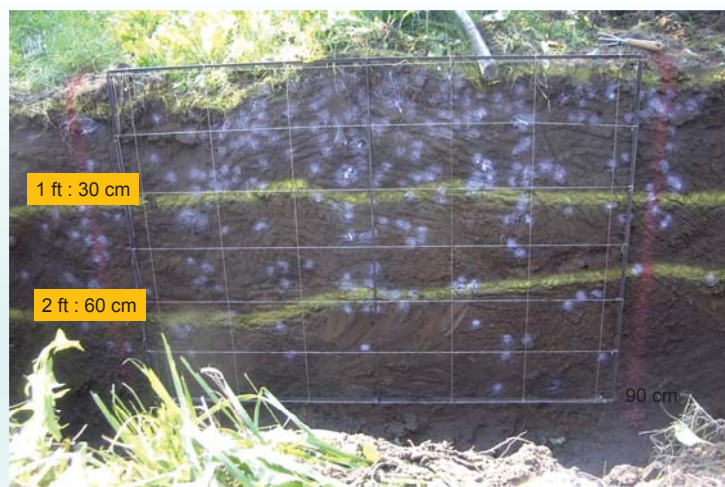
If these trees had been exposed To water for that length of time in summer, they would not have survived

Some flooding can be beneficial To fishermen, too !!



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87



Basically, most roots are found in the top 1.5 to 2 ft of the soil surface.

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85

Alleviate physical restrictions.... which restricts root growth and drainage



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Growing Fruit Trees in wet/heavy soil; Raised Bed



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- Peach and Sour Cherry trees had improved productivity and survival after 10 yrs on medium size, wide bed (30 cm high, 2 m wide).
- Apples on MM 106, not affected by bed treatments

89



Plant apples so that the Union is 4-6 inches above soil level.



Plant stone fruit (peach, cherry, plum, apricot) so that the Union is 1-3 inches above soil level.



Trees settle after planting in augered or large holes



- Expect trees to settle in soil planted the previous spring.
- Reduce settling with packing soil around roots and watering immediately after planting.
- Minimize hole size to reduce potential for settling.



- Do not fertilize until mid summer.
- Roots can and should be pruned back to fit hole / furrow
- Water as soon after to remove air pockets and moisten roots

Impact of scion rooting in apples



Golden Delicious on M.26

Not an issue in stone fruit

94



Emerging Dogwood borer (DWB)



Burr Knot



Compost is fine as long as aged

Fall Plant Video – 1:30 min

- Burr Knots prevalent in M.9; adventitious rooting initials
 - Root initials extend when exposed to soil



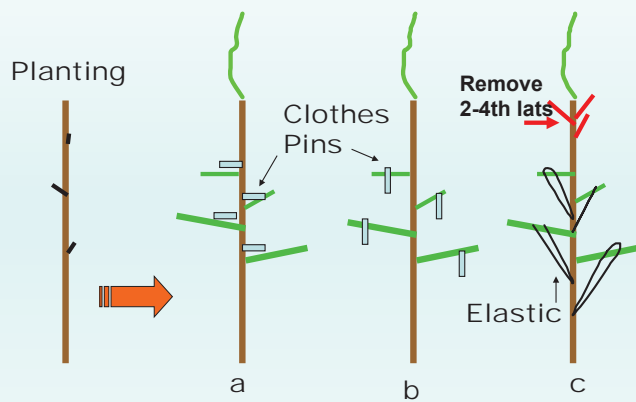
Water and Prune



Water immediately after to drive out air pockets & avoid roots drying and insure root / soil moisture contact

70 – 80 % of roots of a bare rooted tree remain in the nursery, Must balance limited roots with top
 *Cut stem at 36" above union
 *Unless 6-8 very good branches come with tree, prune all laterals back to 1" stubs

Whipped Tree - June/July Yr 1



Training in First Year



Pinching 2-4 competing laterals



Developing The lower branches Training branches by keeping Them near horizontal



Planting / Pruning



Whipped Tree



Feathered Tree

102

Leave trees unpruned in Tall and Super Slender Spindle



- Only recommended where trees are planted 2-3 ft or less in distance.
- Prefer trees to begin weak and maintain weakness (reproductive)

105

Aftercare and Training



- Provide support stake and, establish entire support system soon after planting
- Water regularly to keep trees from stress
- Begin training young branches
- Pinch off competing new shoots/buds below leading bud or stem.



Recently planted Tall Spindle Trees

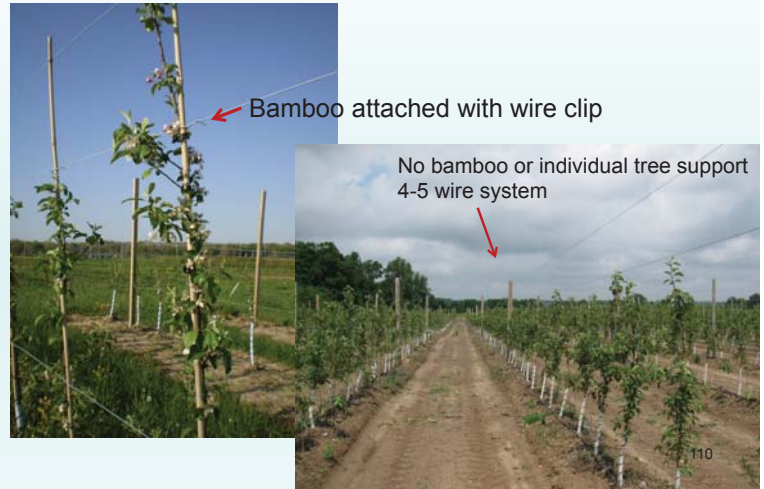
1. Unpruned at planting
2. Leader connected to bottom wire
3. Mounded
4. Branches brought down using 20 ga. floral wire or elastics

106

Trellis / Tree Support



Wire and tree support



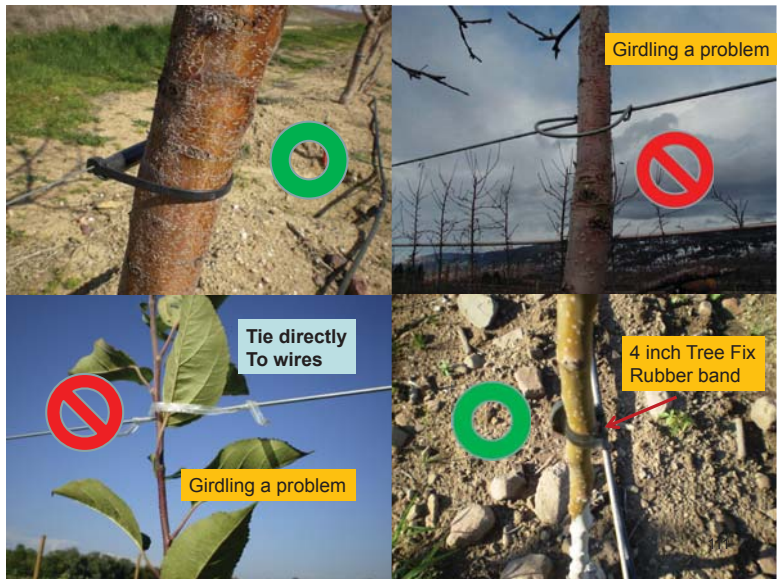
Support Necessary



- Gravity; fruit weight & fruit on small branches
- Canopy volume is lost
- Crop weight can cause load to topple tree / brittle root system



R. Perry, Hort Dept,
MSU



Special support... use of bamboo



Training and Developing the Espalier

- Train and develop plant material to grow in a creative design.
- Historically, began with fruit in Chateaux of France.
- Often in a narrow plain against a wall back-drop / support.
- Must be grown on dwarfing rootstocks.... precocity and natural control of vigor
- Requires attention to detail all through the summer.
 - Routinely weekly or biweekly tying and pruning
 - Retain weak growth in preference over strong growth

Growing Fruit in Espalier began in France in Chateaus



Reimen Gardens,
Iowa State University



Espalier

Creative Designs

Shoot development follows
A specific creative pattern



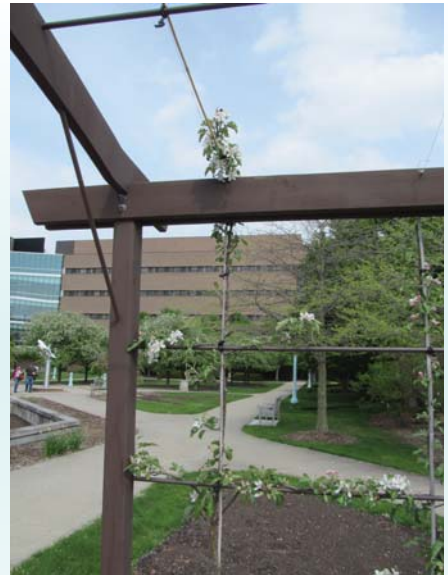
16th Century

Needed to use dwarfing
Rootstocks for primarily
Pears and Apples



Michigan State University
Horticulture Gardens

Gravitated to the home gardens using dwarfing rootstocks



Training and Development of the Espalier



Scoring leaders and trunks:
 Purpose: disrupt apical dominance without removal of apical bud.
 Most successful on younger growth

Best tool is a hack-saw blade.

Cut about 1/3 third Circumference

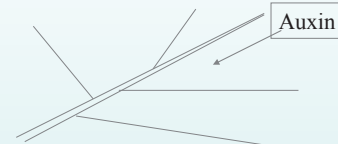
Into wood



Train branches to fit into design:

- Avoid retaining branches that develop above grid line unless this is the intent.
- Score if need to generate a branch on the leader from a specific site/direction.

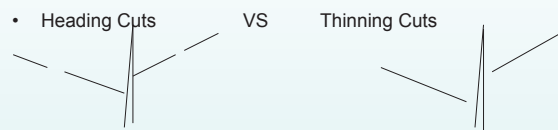
Principles to Pruning: Plant Responses to Pruning



- **PRUNING OR REMOVING APEX DESTROYS SOURCE OF AUXIN = MORE BRANCHING IMMEDIATELY BELOW THE CUT**
 - Apical bud damaged
 - In this photo; similar to head cut



Types of cuts



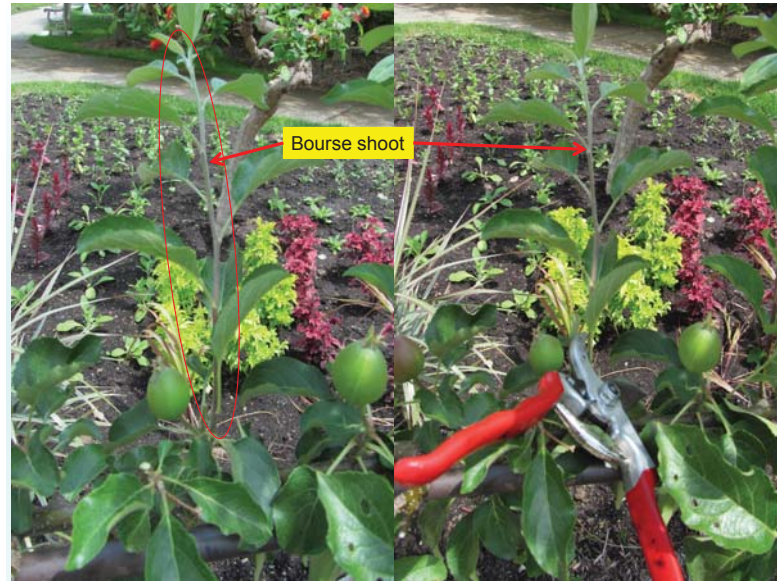
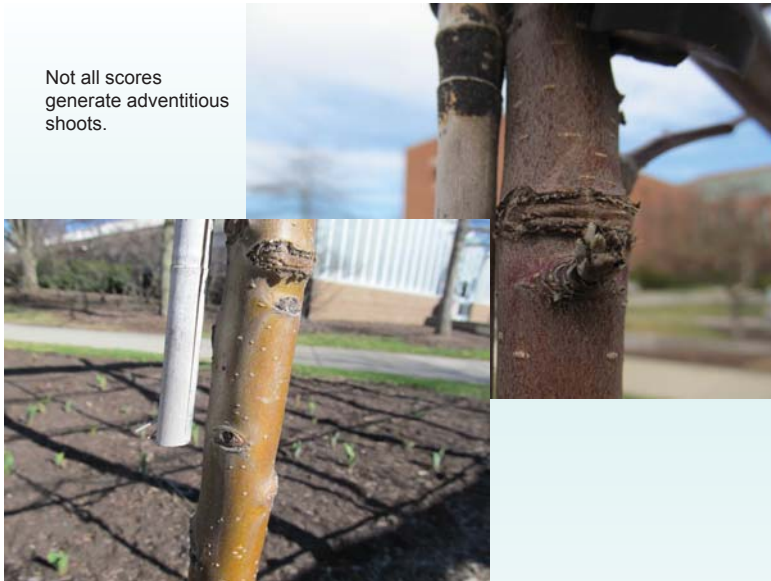
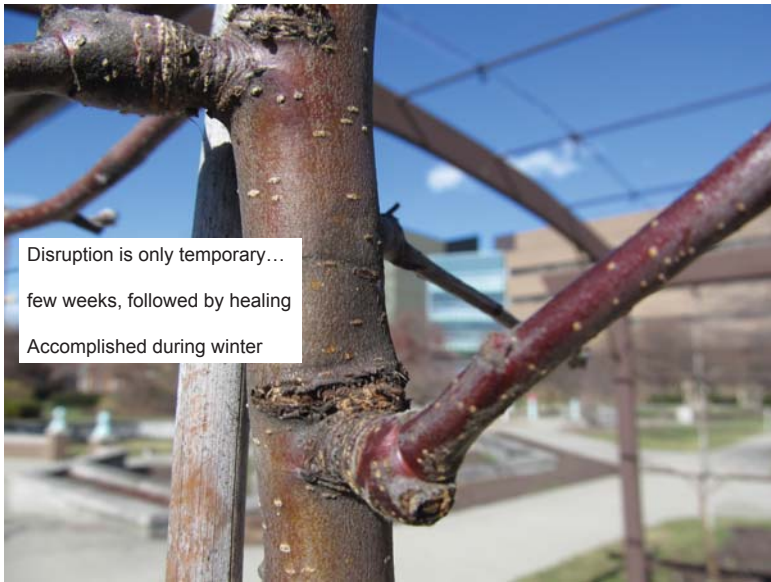
Heading cuts or tipping

- cut made between shoot origin and terminal = creates new form (destroys apical dominance)
- Stiffens limbs
- Prevents terminal bearing fruit production, ie, Idared apple
- Mainly useful in trng young trees or rejuvenating wood

Thinning Cuts

- Remove laterals at point of origin
- Increases vigor of stem tip without inducing lats. Buds
- Improves light pene., redirects limbs, shortens branches, enhances reproductivity (spur development)
- Encourage fruit production for bearing trees

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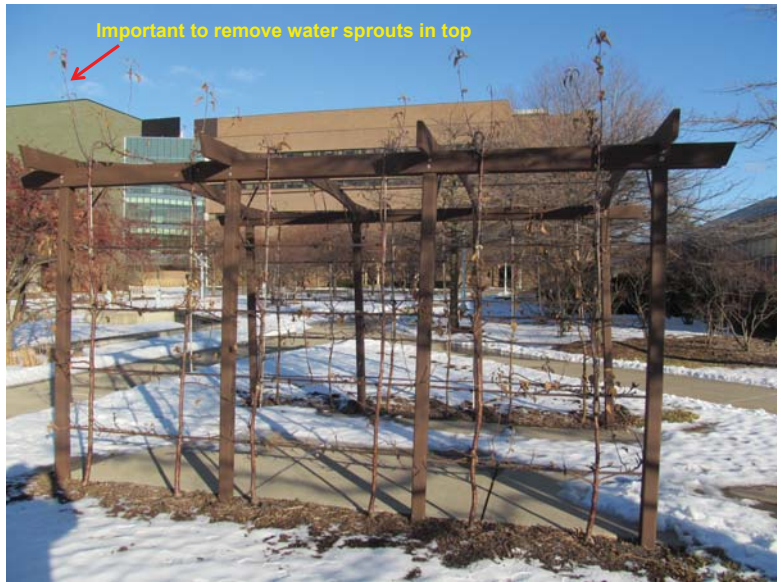


Train during the summer

- Remove upright strong growth.
- Heading cut of the upright after several inches of growth back to stub of 2-3 buds.

Apple: bourse shoot length and occurrence depends on variety





Training Trees for Espalier has taken to commercial settings;" Lincoln Canopy"



Pruning and Training



Winter pruning

Vase or Open Center



Peach



Pears



Summer Pruning

1. Routinely done mid summer
Apples: avoid in humid weather; FB
2. Avoid early summer (June); to avoid Encouraging growth-flush
Avoid after early to mid August; to Encourage fall acclimation
3. Response from mid summer prune Apples



Concept: Crop competes with shoot growth



Traditional Orchard Self-supported

Central Leader 10 X 18'



R. Perry, Hort Dept, MSU

Commercial Orchards Today Mimic Espalier Training and Support Systems



Slender Spindle System

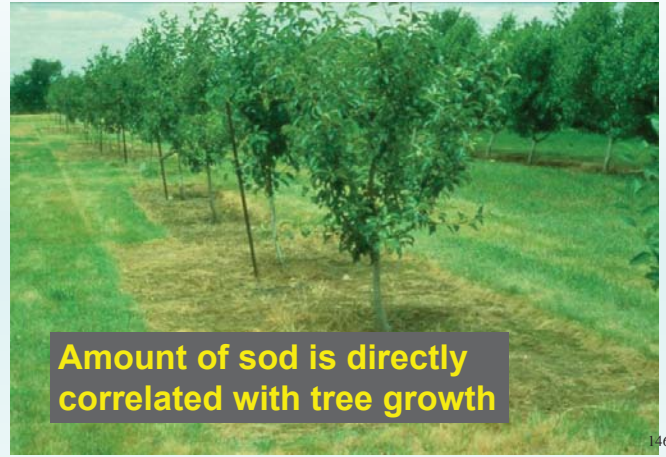
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Slender Spindle/M.9



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Sod Competition Studies, MI (Parker and Hull)



Amount of sod is directly correlated with tree growth

Super Slender Spindle/M.9



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Differences in Plant Growth

Continuous sod

2 ft wide clean strip

4 ft wide clean strip



(Parker and Hull)

Ground Floor Management



Complete tillage

Root Distribution and the Underground Environment



Weeds compete with tree roots

Cherry-Ron Perry



Weeds may compete for pollinators, serve as alternate hosts or provide cover for pests or predators.

(Fruit Crop Ecology and Management MSU Extension Bull. E-2759)⁴⁹

Swiss Sandwich System

Simplifies cultivation but limits competition



152

Weeds must be suppressed, otherwise, trees weaken



Commercial growers use herbicides



Weeds rob nutrients

MICHIGAN STATE UNIVERSITY

Tree Nutrition

- In general, tree fruit crops obtain sufficient amounts of most essential elements from the soil.
- In Michigan orchards, N and K are commonly deficient, and Mg, B, Ca, Mn, and Zn are occasionally deficient.
- Neutral soil pH best (6.5-7.2)
- Course soils require more frequent applications of N to supplement needs.

Soil Health

Clean cultivation gradually reduces soil OM, microbial diversity, and general soil "health".

Sod or weed cover tends to maintain soil OM and sustain biological diversity.

Vegetation serves as a nitrogen trap, absorbing and retaining excess N, reducing leaching.

151

Effect of C:N ratio on N availability

	C:N ratio	
Sawdust	500:1	Reduced available N
Bark	120:1	Reduced available N
Straw	80:1	N
<hr/>		
Compost	25:1	Increased available N
Fresh grass	20:1	Increased available N
Chicken manure	6:1	N

30:1



154

Nitrogen

Primary nutrient used and needed by fruit trees

Recommended N rates for low, medium and high density apple orchards, mature.

N* rate	Trees per acre		
	80	250	500
Ounces per tree	10-12	3-4	1-2
Pounds per acre	60	55	50

Pounds of actual N per acre or tree....

E. Hanson



Soil Type Affects Nutrient Needs



Nitrogen stress (deficiency) 3 yr old peaches, HTRC Sept 2009

Bitter pit; localized deficiency of calcium in fruit flesh



Typical Ca concentrations (mg/kg of dry weight) in apple trees

	Vegetation		Fruit	
Leaves	14,000		Pedicels	5,600
Branches	6,100		Seeds	2,000
			Peel	600
			Flesh	200

E. Hanson



Where to start?

- Growing Apples in the Home Orchard, HYG-1401-00
- Ohio State University FactSheet
- Horticulture and Crop Science
- 2001 Fyffe Court, Columbus, OH 43210-1096