

Winter Pruning for Best Results

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- **Pruning: removal of a branch by mechanical means.**
- **WHY:**
 - **Facilitate ease of cultural practices**
 - **Increase light penetration**
 - Better fruit bud differentiation
 - Better fruit color & quality
 - Faster wound healing with UV light
 - Better flower bud development of flowering trees
 - **Decrease mechanical injury to fruit & limbs**
 - Limb rub
 - Fruit abrasion

WHY:

- **Decrease fruit-bearing surface: better ratio of foliage/fruit**
 - **Better fruit size**
 - **Decrease fruit numbers**
 - **Decrease alternate bearing**
- **Renew growth**
 - **Renews spur growth and vegetative growth**
- **Maintain training system / structural framework**
- **Remove broken, dying, & diseased branches**
- **Better canopy air circulation= less disease, fruit cracking, better wound healing**

What happens to un-pruned trees?

- **Trees are Larger**
- **Many branches; bush form (multi trunk)**
- **Yield small fruits**
- **Dense canopy**
- **Bark inclusion**
- **Poor structure / framework**
- **More broken and diseased branches**

Plant Responses to Pruning

- Pruning is a dwarfing process, that stimulates growth at localized sites ?

FIGURE 6

Pruning severity on growth of Delicious
(Barden, DelValle, and Myers, 1989).

Pruning severity	Shoot growth/limb		
	Shoot number	Average length (cm)	Total growth (cm)
0	20.4	19.6	402
1	16.0	23.6	361
2	14.9	24.8	362
3	8.4	29.6	244

FIGURE 12

Pruning severity on growth of young peach trees
(Savage, et al., 1942).

Pruning severity	Trunk circ. (cm)	Root dry wt. (kg)
Light	34.3	13.0
Heavy	30.5	9.7

From: Myers, S.C. and A. T. Savelle. 1996. Coordination of Vegetative and Reproductive Growth: Root restriction, branch manipulation and pruning. In, *Tree Physiology Growth and Development*, pub. by Good Fruit Grower, pp 69-80.

Pruning.....

- Removes usable reserves, both nitrogenous and carbohydrates.
- Reduces next years' growth potential
- Loss of cambial /meristematic surface = net loss in wood growth
- Growth near cuts is stimulated; overall, tree is reduced or dwarfed.
- Therefore: pruning increases shoot growth but reduces total shoot and root growth.

From: Forshey, C., D. Elfving and R. Stebbins. 1992. *Training and Pruning Apple and Pear Trees*. Pub. By Amer. Soc. Hort. Sci., 166 pages

Plant Responses to Pruning

Young Trees

- Delays onset of fruit production in young trees
- Reduces yields in early years
- Strengthens framework scaffolding in young trees

• Mature Trees

- Reduces stored carbohydrates in wood.
- Reduces numbers of growing points (thus, stimulant)
- Reduction in canopy volume – reduces rooting volume.
- Large cuts stimulate re-growth near the local cut.
- Small cuts spread stimulus over entire tree
- Improves light penetration; stimulates growth in lighted areas

Concept – Pruning should be avoided !!

- Pruning is a corrective action !
- Avoid if possible !
- Train and select branches as plants develop
- Consider branches as an investment – if removed early, little loss; if wait till mature, large loss and impact

Tree form to intercept light penetration

Bad form!!



Upside-down tree, shading growth below

Good form!!



Pyramid form to encourage good light interception

Localized Response

- Apical Dominance: Amount of control displayed by terminal (apical) bud or growing tip over buds nearest the center of tree.
 - Apical bud produces hormones (primarily auxin) which moves down stem and inhibits lateral bud break.
 - More auxin = less lateral budbreak; ie, sweet cherry
 - Less auxin = more lateral budbreak; ie, sour cherry
 - Water sprouts have few laterals, thus high in auxin concen.

Effects of shoot orientation on apical dominance

- Total shoot growth is greatest in terminal sections of limbs and is greater in vertically oriented limbs (Myers and Ferree, 1986).
- As limbs become more horizontal average shoot length decreases (Myers and Ferree, 1983)

FIGURE 1

Natural limb orientation on shoot growth of Delicious/M.9 (Myers and Ferree, 1986).

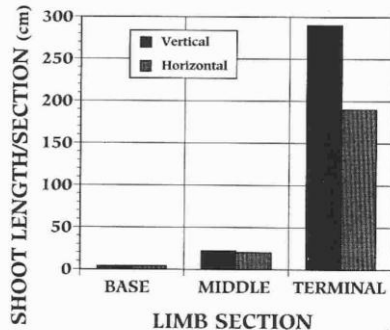
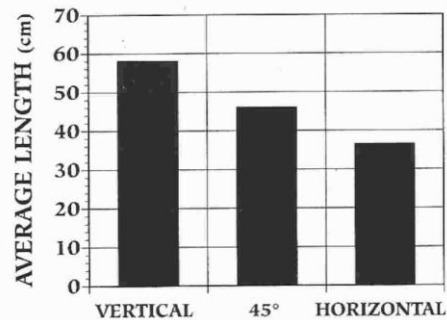


FIGURE 3

Orientation affects shoot length of young apple trees (Myers and Ferree, 1983).

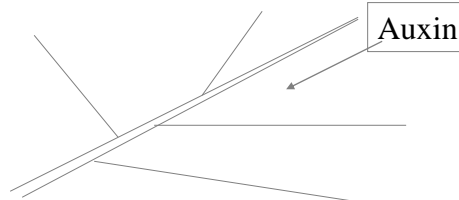


Localized Response

- Removal of apical buds by pruning releases lateral buds from dormancy.
- Results in more lateral growth at expense of terminal.
- Increased shoot growth = decrease in flowers and fruit (direct competition)
- Result is that pruned trees have more growth promoters (cytokinins, auxins and gibberellins) early in the growing season = greater shoot growth.

From: Forshey, C., D. Elfving and R. Stebbins. 1992. Training and Pruning Apple and Pear Trees. Pub. By Amer. Soc. Hort. Sci., 166 pages

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



Auxins Influence Branch Angle

- Hormones produced by the apex bud also control branch angle of lateral shoots below
- Terminal buds on laterals above other laterals is an additional source for auxin, which explains the reason for branches nearest the apex having more narrow angle crotches than farthest from the apex



Pruning style... many small cuts VS fewer large cuts.

- Numerous small cuts (detailed pruning) stimulates more shoot growth, and alters canopy form more than bulk pruning (large cuts).
 - Removes more terminal growth points and is more disruptive to PGR balance than bulk pruning.

From: Forshey, C., D. Elfving and R. Stebbins. 1992. Training and Pruning Apple and Pear Trees. Pub. By Amer. Soc. Hort. Sci., 166 pages

Pruning effects on photosynthesis (Pn): Reduction in leaf area

Pruning in Dormant Period

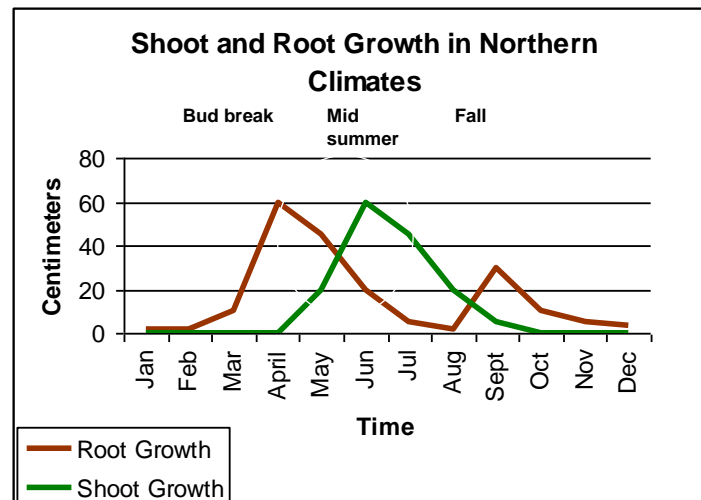
- Removal of buds reduces leaf area, and Pn potential, early in the season.
- By mid summer, increased shoot growth = catches up in total leaf surface area

Pruning in Growing (Summer) Season

- Pruning in early growing season can stimulate growth and Pn
- Pruning after apical buds set = irrevocable loss of leaf surface = loss in Carbohydrates (CHO)

From: Forshey, C., D. Elfving and R. Stebbins. 1992. Training and Pruning Apple and Pear Trees. Pub. By Amer. Soc. Hort. Sci., 166 pages

Relationship between shoot and root growth



* For fruit trees growing in Michigan

Pruning effects on photosynthesis (Pn): can enhance or block light penetration

Enhancement (often, thinning cuts)

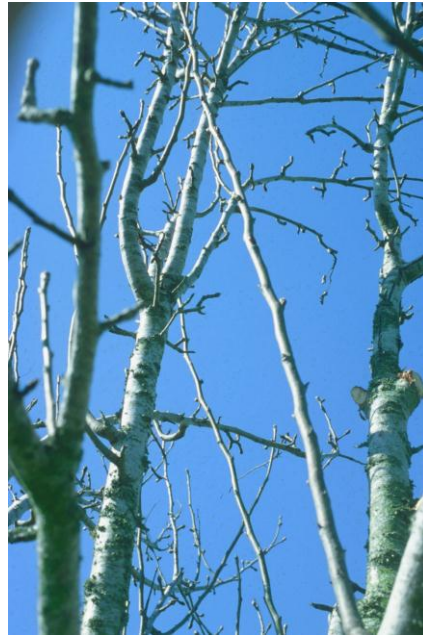
- Can open the canopy to allow more light in for:
 - UV light to heal up wounds and avoid rotting pathogens
 - Encourage better flower and fruit development
 - Encourage production of CHOs for storage in wood and roots

Blocking (often, heading cuts)

- Severe pruning = more shoot growth and shading
- On interior or exterior

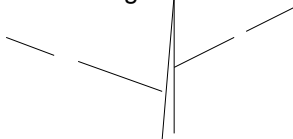
From: Forshey, C., D. Elfving and R. Stebbins. 1992. Training and Pruning Apple and Pear Trees. Pub. By Amer. Soc. Hort. Sci., 166 pages

Thinning growth
in interior of
canopies:
reduce crowding



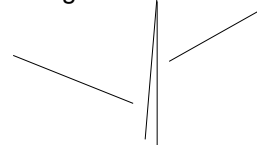
Types of cuts

• Heading Cuts



VS

Thinning 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
- 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

R. Perry

Important points about pruning and cuts

- Use thinning cuts when- and where-ever possible.
- Avoid heading branches at the ends of the main branches (scaffolds). That promotes more pruning needed next year.
- When in doubt leave it in and look again in the summer when there is less compensatory growth.
- Do not use wound sealing compounds....let UV light help heal wounds.

Timing of Pruning: effects on physiology

Pruning during the dormant season

- Least negative effects on plant processes
- Gives wounds/cuts more time to heal
- Most diseases are inactive in cold climate and thus, less potential to spread
- Best time for corrective framework (large) cuts
- Response in compensatory (localized) growth is greatest
- Least negative effects on root system
 - Large root system in dormant state with stored reserves of carbohydrates and plant hormones.
 - Root system given time to regenerate during bud break to compensate for branch loss.

Is there an optimum time to prune in dormant season? YES

- In cold climates, accomplish as late in winter as possible
 - Pruning stimulates meristematic cellular activity of latent buds near cuts.
 - Tissue loses cold hardiness
- **Avoid fall or late fall even if leaves have dropped.**
- **Prune cold hardy/species/varieties first** (early winter).
- **Prune old specimen first** and young plants last (late winter).
- Fireblight apple remove infected growth winter or driest / hottest days of summer and disinfect pruners between plants

Pruning Fruit Trees

- Developing and Training Young trees
 - Follow a plan or system... the most common historically for Apple is:
 1. Central Leader and Modified CL – traditional sys
 - » Non supported, extensive, semi vigorous stocks typically 200 – 350 tree / Acre
 2. Vertical Axe
 - » Supported, intensive, dwarf stocks, 500-650 T/A
 3. Slender Spindle
 - » Supported, intensive, dwarf stcks, 800-900 T/A
 4. Super Slender Spindle
 - » Supported, intensive, dwrt stcks, 1500-2500 T/A
 5. Tall Spindle
 - » Supported, intensive, dwrf stcks, 1200-1300 T/A

Central Leader System (Pyramid)

- **Central Leader** is a traditional system for apple
- Applied to large trees, with framework development to bear crop with need for additional support.
- **Sacrifice crop production** in early years to develop framework.
- Trunk forms central axis, **central leader** is dominant feature, maintains vertical growth.
- Requires a strategic understanding in developing frame.



In other species, leaders maintain dominance through intervention (pruning and training).

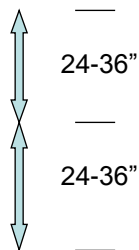
Overtime - Leader in many cases loses dominance due to gravity and weight of canopy/fruit, etc



Pecans

Develop scaffolds in tiers (2-4 depending on height)

Ultimate ht. — 14-30'



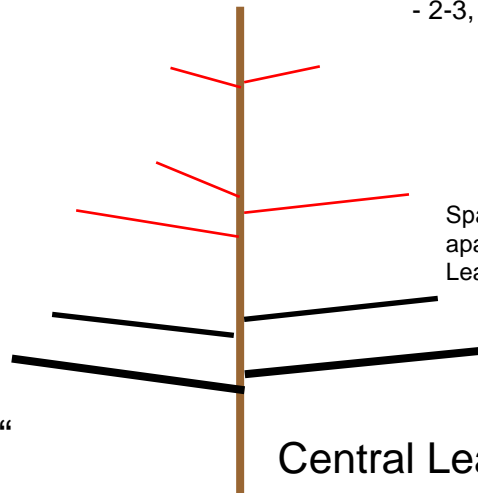
Develop Whorls
- 2-3, Tiers of scaffolds

Tier 3, temp

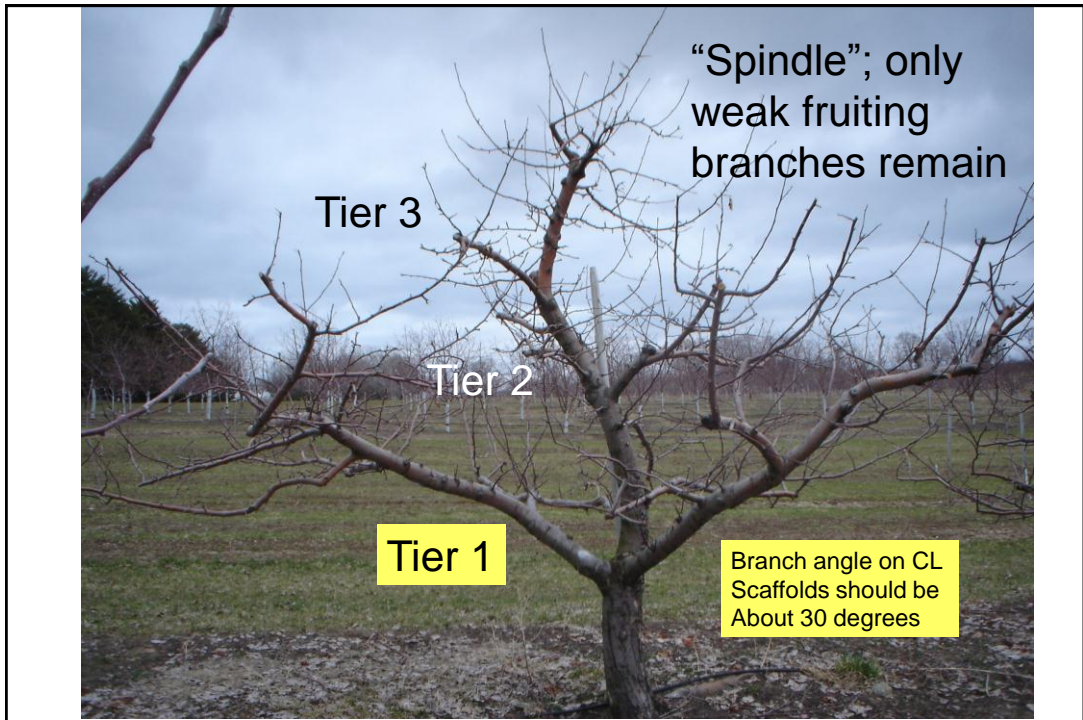
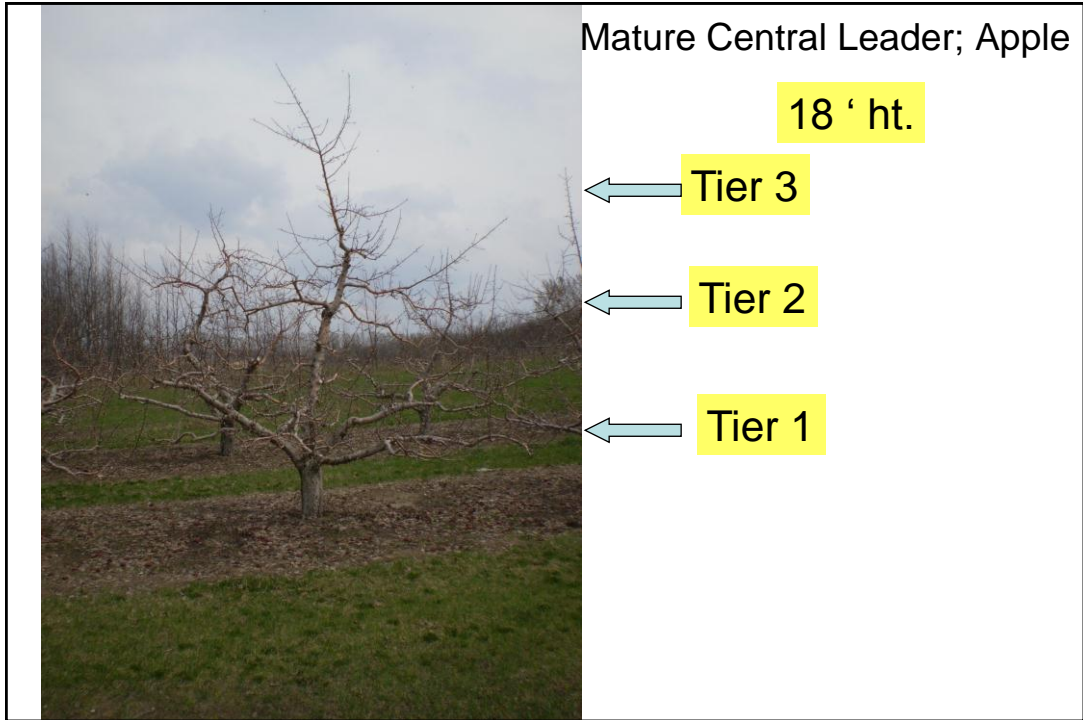
Tier 2

Space scaffolds 6"-12"
apart vertically on the
Leader at each tier (level)

Tier 1



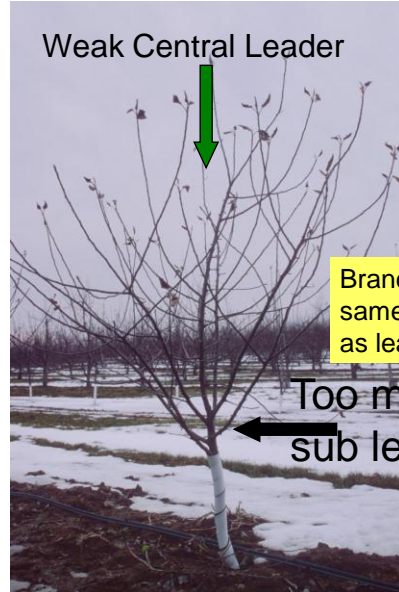
Central Leader System



Developing the Central Leader: Years 2-5



3 sub leaders



Weak Central Leader

Branches same size as leader

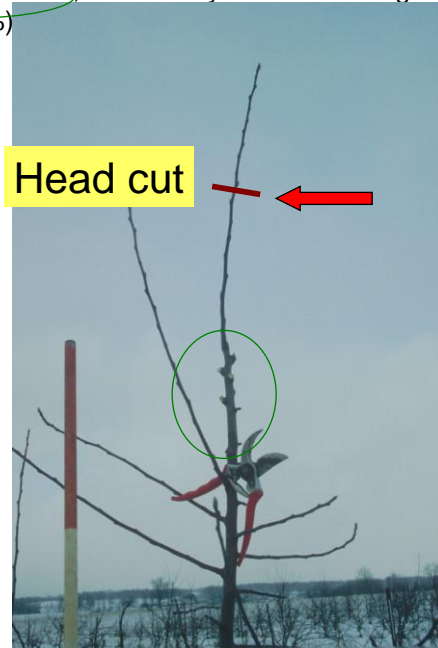
Too many sub leaders

Central Leader dominance lost
Leader Choked

Keep CL dominant; remove first competing laterals, followed by annual heading of CL (50%)



Head cut



Removing vegetative upright sprouts

8 yr old Mac / CL

Calm top



Keys in First 5 years of Central Leader System

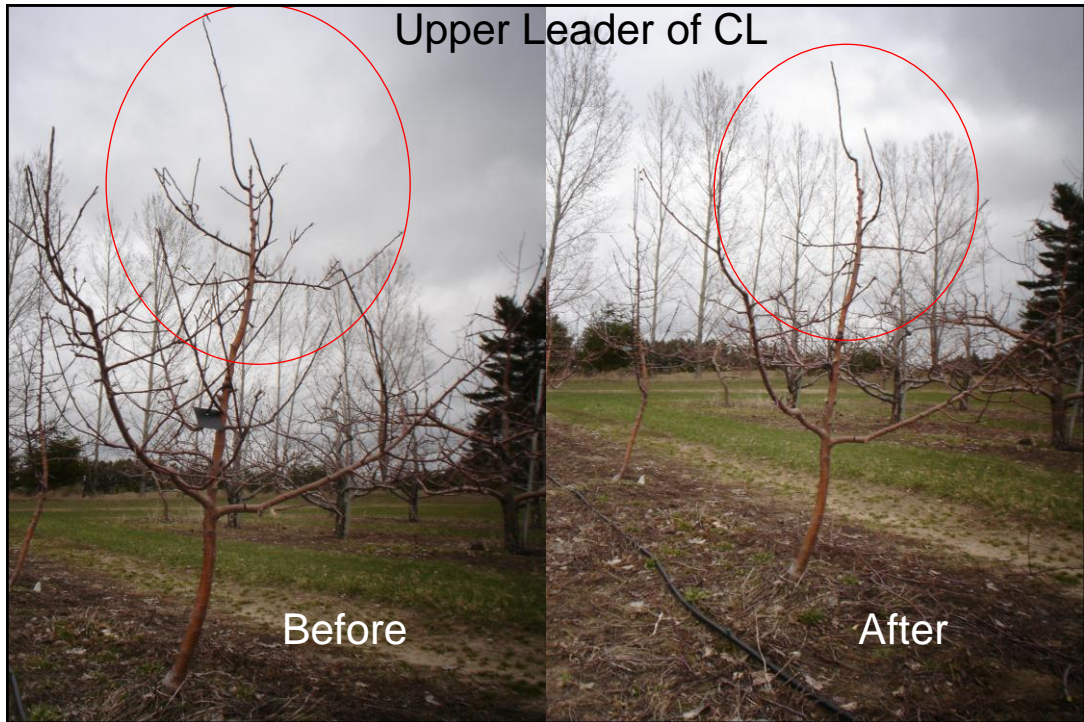
- Remove fruit from developing leader (1-2 yr old growth)
 - **“Sacrifice crop production in early years to develop framework”.**
- Do not allow any branch to develop that exceeds caliper of more than 50 % of caliper of leader at attachment!
- Spread limbs to appropriate angles (30 degrees)
- Do not allow too many branches at each tier (3-4) to develop.
- Keep branches spaced to avoid crowding, allow light and avoid “choking”

Keep branches spaced to avoid crowding,
allow light and avoid “choking”



**Cropping, especially on precocious (dwarfing) rootstocks,
eliminates dominance of Central Leader**





Mature Central Leaders, eventually gravitate to Modified Central Leaders: Pruning is done with large cuts to keep windows open to allow light to penetrate



High Density Systems, using **dwarfing rootstocks**, apply to Vertical Axe, Slender Spindle, Super Slender Spindle and Tall Spindle

- No understanding of framework necessary.
- Central leader remains dominant by tying to vertical support
- Can allow fruit to develop with minimal consequences
- Ignore rules of branch spacing in CL
- The 50% rule does apply: leave only small weak branches



Headed feathered tree for Vertical Axe or Slender Spindle
Bend feathers below horizontal for SSS and TS and do not head at planting



Vertical Axe System



Leader supported "Vertical Axe

Branch angle on Table of Production should be horizontal

Training Branches - VA



Remove branches > 50% of leader caliper



Spread branches as they form to gain wide angle

Keep branches < 50%

Let Fruit Control Top in Axe



Calm Tree; No Pruning Needed



Pruning Necessary (Gala / M.9 EMLA)

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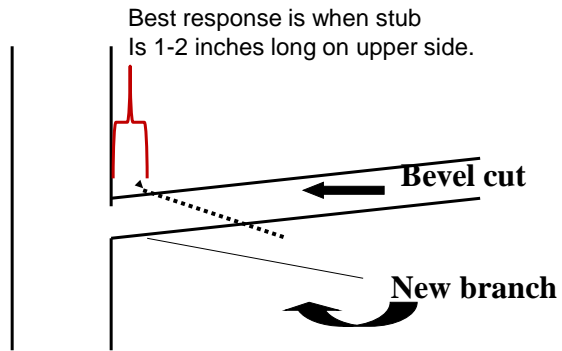
Good Management in Axe Yields Continued Production of High Quality Fruit



Gala / Bud.9 after 10 yrs

Making A Bevel Cut to Recycle Branches

As trees mature,
focus on
watersprout
removal,
removal of thick
and
large branches



“Bevel Cuts”



Bud forced on upper side
Of branch stub (cut).



Bud forced from under side
Of branch bevel cut.



Remove and
recycle branches
that are too large
(exhausted space)



