# Guidelines for Annual Maintenance Pruning, and Severe Renovation Pruning, of Apple and Pear Trees

**Steve Gaber, NW Fruit (Western Washington Fruit Research Foundation), Mt Vernon, WA.**

These guidelines are designed for non-commercial growers who have well-established apple and pear trees. Since many issues for maintenance pruning (Chapter 1) and renovation pruning (Chapter 2) are similar, this paper addresses both. There is no rigid formula for pruning, giving the grower great flexibility. However, there is widespread consensus on the necessity of allowing light and air to penetrate the canopy.

**Key issues:** Canopy density and the proper balance of fruit-bearing wood to leaf-bearing wood are fundamental to tree health and fruit production.

**Annual Maintenance Pruning:** This involves ongoing maintenance pruning on trees pruned within the last 2-3 years, to control tree size, and canopy density.

**Severe Renovation Pruning:** Using simple yet severe techniques, even the canopies of trees neglected for 20 years or more can be restored to a shape and density that can be maintained with ongoing annual pruning.

**When to Prune:** Apple and pear trees can be pruned without harm at any time of the year in the Pacific Northwest, USA. Check with local specialists in other regions for advice on timing if diseases such as fire blight are prevalent.

Most non-commercial growers find that one annual pruning, either in the summer or in the winter, meets their pruning goals.

**Summer Pruning, mid-July through August:** Pruning away foliage during the summer growing season reduces the flow of nutrients stored in the roots for next summer's growth, reducing vigor. Most trees can benefit from reduced vigor during the growing season.

- **Considerations for Summer Pruning:**
    - Helps control vigor, improve fruit quality, and maintain manageable tree size, making it a preferred one-time-a-year event for many non-commercial growers.
    - Heading back new shoots can promote the formation of fruit buds a year early. This also improves fruit-bud development on tip-bearing trees.
    - The tree looks "recently pruned" for 9-10 months of the year.

**Winter Pruning, February to April:** Pruning during winter tends to promote vigorous tree growth the following summer. Fully recharged reserves stored in the roots from the previous summer are channeled to stimulate growth in a reduced number of buds left after winter pruning.

- **Considerations for Winter Pruning:**
    - If an old, slower-growing tree needs revitalization or a young tree needs stimulation for increased growth, winter pruning can help increase vigor.
    - All the leaves are off the tree, making it easier to see what needs to be pruned.
    - More vigorous growth is beneficial if needed to expand the size/height of the tree or fill in gaps in the canopy.

**How much to prune:** When managing vigorous, mature trees that have already reached their desired size, removing 75% or more of the new growth, as well as significant older wood, is needed to restore a proper density. The amount of wood removed should about equal the amount of new growth since the last pruning to maintain equalibrium.

# Chapter 1- Guidelines for Annual Maintenance Pruning

**Step 1: Prune for the "4-Ds"** Remove these undesirable branches:

- **Dead**
- **Diseased**
- **Damaged**
- **Deranged/Dysfunctional** (e.g., water sprouts, crossing branches, in/up/down pointers)

**Step 2: Prune for Height, Width, and Density**

- Remove old structural or scaffold wood to reduce height, width, or density as needed, leaving branches that generally radiate outwardly from the center of the tree. About 10 feet tall is a convenient height for future pruning and harvesting.
- Make **renewal cuts** to maintain proper density and develop new fruit-bearing laterals. Older wood eventually becomes unproductive. It should be removed in all areas, including scaffold, lateral, or fruit spur level, so new wood can replace it, grow, and fruit. Find 3-5 year old laterals and make a thinning cut (renewal cut) at the branch collar on the scaffold branch. This will stimulate new shoots during the next growing season that will come from near the renewal cut and other sites on the scaffold branches.
- Repeat this technique in a 3-5 year cycle, removing 1/3 to 1/5 of old laterals with renewal cuts each year. Keep branches on the tree that are in each stage to promote a crop each year and maintain balance.
- For open center trees, leave a “hole” in the center of the canopy, where most branches are pruned away. The hole should be a nominal 20% of the canopy

diameter. For instance, a 25-foot diameter canopy would have a 4-6 foot hole in the center, producing a donut-shaped canopy.

**Step 3: Prune the Remaining New Shoots** They are the future fruit-bearing laterals and, above all else, their treatment directly impacts long-term fruit quality and quantity.

**Follow the "3-Nines" Guidelines for new shoot density, length and orientation.**

- **9" Apart**: Prune off excess new shoots, and older wood for renewal, leaving the remaining new shoots and laterals spaced about 9" apart, or more.

- **9" Long**: For new shoots that are left, prune them back with a heading cut to a nominal 9" long (approach #1). This length can easily vary between 4" and 14" depending upon space available. Leave the terminal bud on new shoots that are shorter than ~15".

- **9 o'clock-to-11 o'clock**: The remaining new shoots should lean outwardly toward the circumference at an angle between 9 o'clock and 11 o'clock (0-60 degrees from horizontal).

**There are two approaches to pruning new shoots:**

**Approach #1**: Head back the new shoots, leaving them about 4"-14" long (Fig. 1 and Fig. 3). These shoots originate from an existing lateral or emerge directly from a scaffold branch.

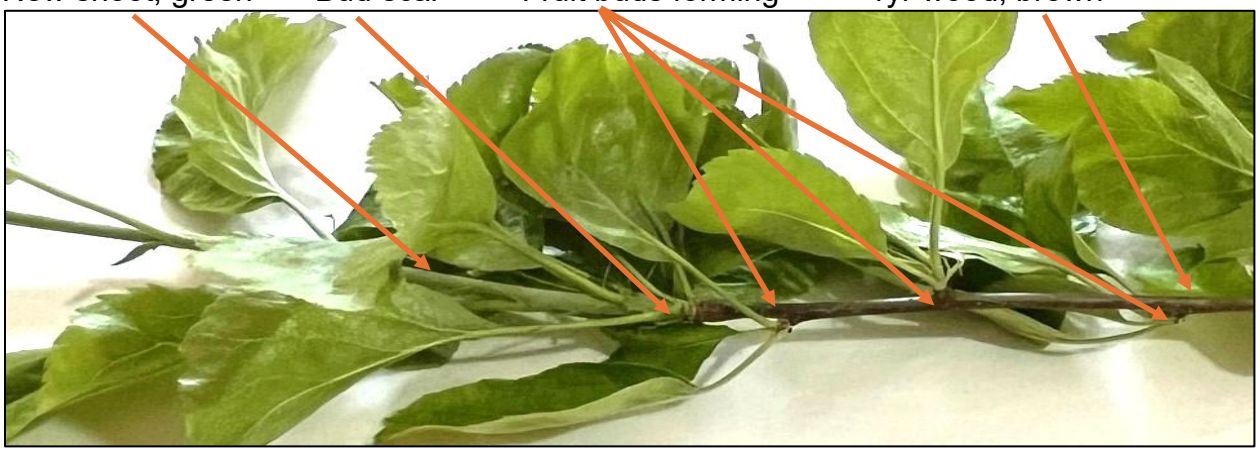
- Used when there is adequate space for the new shoot.
- Next season, several new shoots will emerge from the remaining buds near the end of the shoot. One can be kept and the rest pruned off (Fig. 4).
- Avoid leaving a "fork" at the end of the lateral, as it creates unnecessary density next season.
- Avoid leaving long thin laterals that will bend into each other or break with a heavy fruit load.

**Approach #2**: Alternately for new shoots that originate from an existing lateral, remove the new shoot entirely, only if necessary to restore proper density (Fig. 2 and Fig. 4). Head back into older wood containing fruit buds.

**Examples of Approaches #1 and #2 for pruning laterals**

Fig.1 This lateral was not pruned last year. One new shoot grew from the apical bud at the tip.

New shoot, green  Bud scar  Fruit buds forming  1yr wood, brown



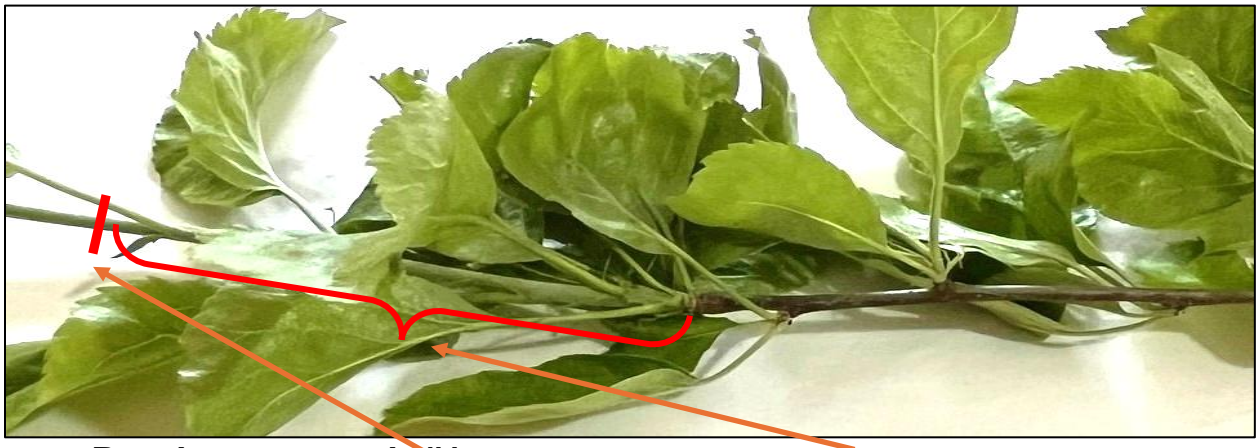


Fig. 2 **Pruning approach #1:** head back the new shoot to leave it 4”-14” long.

Fig. 3 **Pruning approach #2:** Remove the new shoot entirely by heading back into older wood: cut to a fruit bud.

This lateral was a new shoot last year that was headed back, leaving vegetative buds. Two new lateral shoots grew from the buds near the tip.

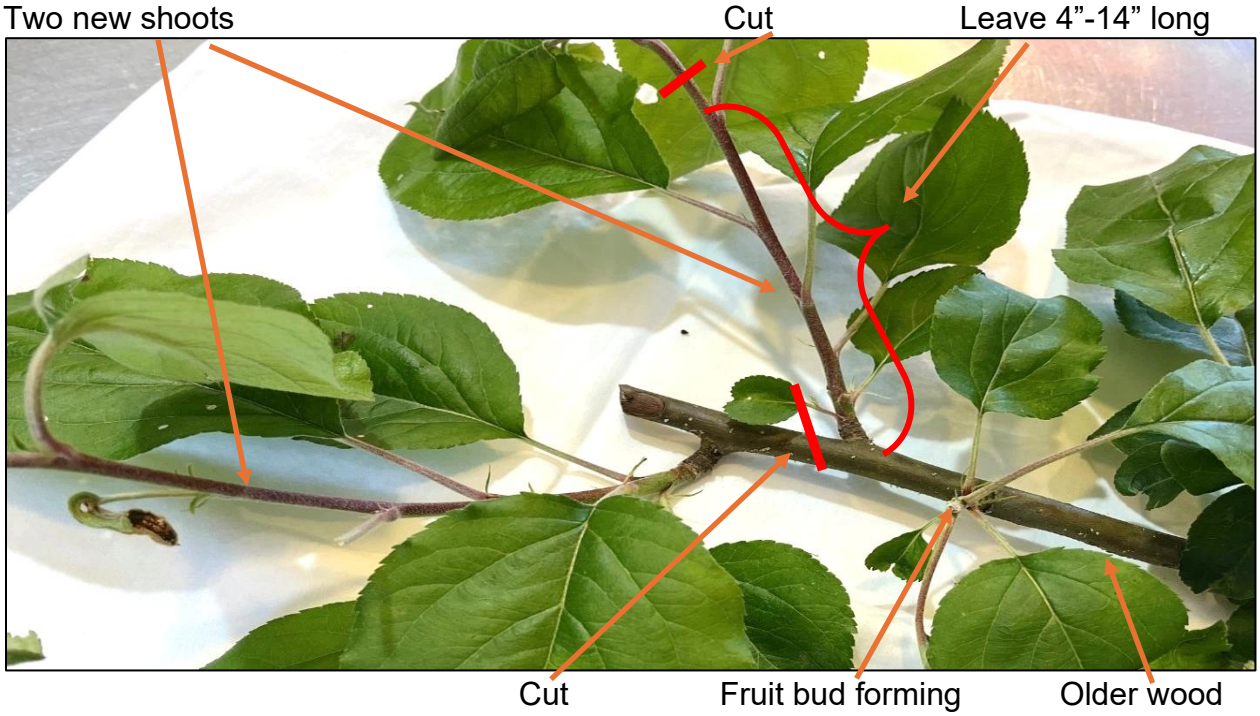



Fig. 4 **Pruning approach #1:** Leave one new shoot and head it back to 4”-14” long. Avoid leaving a “fork” at the end of the lateral, avoiding unnecessary density.

Fig. 5 **Pruning approach #2:** Remove both new shoots by heading back into older wood: cut to a fruit bud. Avoid a “fork” at the end of the lateral.

## Pruning results

Fig. 6 Picture taken 4-19 before “dormant” pruning. This open center apple tree was dormant-pruned about 12 months earlier.

Fig. 7 After “dormant” pruning. Note removal of water sprouts and reduced density of the canopy. Total height ~12 feet.

Fig. 8 Closer view before pruning. Note the congested density of the canopy.

Fig. 9 After pruning with reduced density of the canopy.

Fig. 10

Picture taken 8-2 before summer pruning. This open center apple tree was dormant-pruned in March.

If left unpruned, the water sprouts would reach 2x height by fall.

Fig. 11

After summer pruning.

Note removal of water sprouts and reduced density of the canopy. Total height ~9 feet.

Fig. 12

Picture taken the following April.

Note reduced number and height of new shoots from a **second flush** that grew after summer pruning. Tree will be summer-pruned again in July

Fig. 13 For years, this open center apple tree was pruned every winter to remove all the water sprouts, some 6’ long, and the new lateral shoots from the previous growing season. There is almost no 2 yr wood on this tree, and therefore fruit production was limited. Picture taken 3-9.

Fig. 14 After dormant pruning. All water sprouts were removed and future fruit-bearing laterals remain, spaced a nominal 12” apart. These laterals will produce new shoots to re-develop the canopy. This tree will look similar to Fig 10 by July/August, when it should be summer-pruned.

Fig. 15. Pear blossoms on 1 yr wood pruned the previous summer season.

Fig. 16 New short shoots developed on an apple tree after summer pruning. A **second flush** of new vegetative growth, or even the occasional blossom, are common after summer pruning.

**Considerations of Too Much Pruning:**

- Unnecessarily removes productive fruit buds.
- Removes new shoots that will produce future fruit buds.
- The more that is pruned away, the greater the growth of new shoots during the following growing season.
- Ratio of leaf-bearing-wood to fruit-bearing-wood: There is a useful minimum leaf-to-fruit ratio recommended in the industry when summer-pruning apple trees after the fruit is thinned, but before harvest. For dwarfing trees, it is approximately 10 mature leaves per fruit (around 80 square inches). For standard trees, it is about 13-15 leaves per fruit. These values should be taken as guidelines only, as there are many variables at play.
- If a heavy fruit crop requires extra foliage until harvest, the excess can be pruned away at any time after harvest.

**Considerations of Too Little Pruning:**

- Leaves the canopy too dense, reducing light and air.
- Leaves too many fruit buds, resulting in crowding, over-production, and requiring more fruit thinning.
- Increases the height and/or width of the canopy.
- Does not remove all poorly oriented branches: up/down/in pointers, crossing, weak, water sprouts.

# Chapter 2- Renovation pruning of neglected, overgrown trees

**Characteristics of Overgrown Trees,**

All neglected, overgrown trees share similar features, regardless of age or shape:

- **Excessive Height**: Trees become too tall due to unrestrained leader growth or old water sprouts.

- **Dense Foliage**: Branches and foliage are too dense, restricting light and air into the tree, particularly in the center and lower areas.

- **Tangled Branches**: Branches are tangled, crossed, rubbing, or pointing in the wrong direction. Some are weak and/or too long, making the tree too wide or unable to support a fruit load.

- **Dead/Diseased Wood**: Contains dead or diseased wood, some with obvious cankers. Trunks or structural wood may be hollow or otherwise rotted.

- **Small/Deformed Fruit**: The tree may produce fruit where light and air can reach, but the fruit is usually small and often deformed.

## Overgrown Tree Shapes

There are three common shapes for most overgrown trees:

- **Central Leader Trees**: Originally had a single, central trunk with side scaffold branches forming a conical shape. Uncared for, these trees turn gangly with multiple tall "leaders" that have turned into multiple trunks. The scaffold branches and long laterals may be arched or weeping, and lots of old water sprouts will have grown into sails, thick and tall.

- **Open Center Trees**: Have four to six main structural limbs, beginning 24 to 48 inches above the ground. Growing outwardly, these limbs form a vase or bowl shape 8 to 15 feet tall, at which point they may transition to outward and horizontal. Scaffold branches originate from the structural limbs, and water sprouts propagate from the tops of all the branches, eventually turning into sails. Many heritage trees were trained as open center for ease of maintenance and harvest.

- **Umbrella Trees**: Are extremely overgrown open center trees. These older, neglected, open center trees have developed overlapping layers of long, weeping scaffold and lateral branches that originated from the four to six main structural limbs. These weeping branches started as water sprouts but over time drooped to form an umbrella shape. They may also have thick, overgrown vertical sails, 20+ feet tall. Once renovated, these trees can become stately, specimen trees.

## How Much to Prune

Restoration pruning is dramatically different than annual maintenance pruning. The approach presented here is to reduce the tree to approximately 10 feet in height and do all the renovation pruning in one session. Even when much of the wood is removed during extreme pruning and the tree looks brutalized, an abundance of vigorous new shoots will appear during the growing season. The canopy will be well on its way to a full restoration in a few years.

## Benefits of Removing Excess Canopy All at Once

- **Ease of Pruning and Harvesting**: A tree shortened to approximately 10 feet is easier to reach for pruning and harvesting, starting in the next growing season when lots of new growth will need pruning.

- **Reduced Number of Buds and Risk of Infection**: Every old branch that is pruned away is one less site for excessive new shoot growth or for fungal infection spreading from old wood.

- **Improved Fruit Production**: Training for a new canopy shape and improved fruit production can begin in the first growing season after pruning.

**Renovation Pruning Guidelines**

The following procedures are for common, open center trees, but the same concepts apply to central leader trees or trees that have just "gone wild." The grower can adjust the approach to suit their circumstances.

The goal is that, after final pruning, the canopy for open center trees should:

- Be shaped like a "donut" when viewed from above, with a height of approximately 10 feet.
- Have a uniform density with most laterals and branches separated by at least 12 to 18 inches.
- Have scaffold branches and long laterals headed back to support a fruit load and stimulate new shoots along the branch.
- Retain as many fruit spurs as possible, for continued fruit production.

**Step 1: Evaluate the Tree and Make a Plan**:

- Choose the best 4 to 10 scaffold branches to be saved. It's useful to mark them with flagging tape. They should be robust enough to support the weight of future fruit, outwardly pointing, and evenly spaced around the circumference of the tree, like spokes of a wheel.
- Hollow branches or trunks are acceptable if structurally sound and still vigorous.

**Step 2: Begin with Major Pruning Cuts**:

- Remove excess structural wood that will not be saved. This could be for lowering the height, reducing density, removing crossing or rubbing branches, or removing branches that are too long or in danger of breaking under heavy snow or fruit load.
- Remove all unwanted branches from the remaining structural wood that is saved, including sails, verticals, excess scaffolds, branches in the center, crossing/rubbing/wrong direction, and dead/diseased branches.

**Step 3: Make the Finishing Cuts**:

- Head back the scaffolds and laterals that extend beyond the desired circumference of the canopy to establish the new perimeter of the canopy and stimulate new shoots.
- Use a thinning cut to remove secondary scaffolds and laterals that are too dense, leaving at least 12 to 18-inch spacing between those to be saved.

- Head back older laterals into older wood to promote new lateral shoots, fruit buds, and spur formation.

- Adjust the overall density and shape by removing additional structural wood, scaffolds, or laterals if needed.

**Pruning Guidelines for the Subsequent Growing Seasons**

During the next three to four growing seasons, the grower will contend with an astounding growth of new shoots and can reference Chapter 1 "Annual Maintenance Pruning" guidelines of this paper for future pruning guidelines.

# Before and after examples

Fig 17

Before pruning, severely overgrown open center umbrella apple.

Last pruned: ~14 yrs
Total height: ~30-35’
Sails: ~ 15-20’ long, 2-3” dia.
Layered, dense weeping branches.
Spread: ~40’
Pruned in July.

Fig 18

After pruning

Open center, umbrella tree
Height: ~15’

Fig 19

Dormant period

Weeping branches were thinned and headed.

This tree will bear some fruit next season.

Fig 20

Before pruning, moderately overgrown open center apple,

Last pruned: ~8 yrs
Total height: ~25’
Spread: ~20’

Water sprouts very thick.
Long, weak laterals.
Crossing/rubbing branches.
Dense center.

Fig 21

After pruning in June

Open center,
Height: 8-9’

Long, weak laterals were removed or headed back.

A few fruit buds remain.

Fig 22

Before pruning, severely overgrown open center apple.

Last pruned: ~20 yrs
Total Height: ~35’
Sails: ~ 25’ long, 3-4” dia.
Spread: ~30’

Old water sprouts.
Long, weak laterals.
Crossing/rubbing branches.
Very dense center with few fruit spurs at <10’

Pruned in October.

Fig 23

After pruning

Open center
Height: ~8’

Strong scaffold branches, headed back. Very few fruit spurs remain.

Fig 24

The same severely overgrown apple from Fig 23. In mid-August of the third growing season after pruning.

Lots of water sprouts and vigorous new shoots.

The same tree as Fig 24, after mid-August summer pruning.

Water sprouts removed, new shoots pruned to ~9” apart and 9”-12” long. Gaps in canopy filling in nicely.

# Tree Physiology as it Applies to Pruning Principles

## The Fascinating Process of Converting Sunlight to Fruit

Fruit trees are remarkable solar collectors and fruit producers. The simplified sequence from sunlight to fruit is as follows:

In the spring, the spur leaves in the fruit bud are the first to break dormancy. The reserve nutrients from the roots and bark support the growth of the spur leaves and the blossoms until they bloom a short time later. Blossoms last about 10 days.

After blooming, the support from the reserve nutrients fades. For the next 3 weeks or so, each separate whorl of spur leaves, with its pollinated blossoms, acts as its own little standalone factory for fruit production. The development of the fruit relies almost entirely on photosynthesis from the spur leaves, converting sunlight to sugars.

During this initial phase of 4-6 weeks, it is critical that the spurs have good sunlight exposure to 1) set the fruit, 2) produce good fruit size, yield, and quality, and 3) develop fruit buds for the next year.

Once the new vegetative shoots have grown and leafed out enough, they also add nutrients for the continued development of the fruit. Additionally, they produce nutrient reserves, stored mostly in the roots, to support the initial growth in the following spring.

So, it's easy to see that the goal of the grower is to open up the canopy to allow strong exposure to light and air.

## The Effect of Hormones

There are many complex physiological processes involving hormones and nutrients that control a tree’s growth. Here are some of the factors that apply to pruning, and the subsequent results:

- **Cytokinin** [sīdəˈkīnin] is a hormone created mainly in the roots. It is transported up the tree and is a key player in breaking dormancy of the apical buds, initiating the production of auxin. Cytokinin stimulates new cells through cell division during active growth and also promotes lateral bud formation.

- **Auxin** is a hormone produced in actively growing apical buds and promotes cell elongation and shoot extension in the stem. It flows down the branch by gravity and inhibits new shoots from growing from vegetative buds on last year’s wood.

- **Apical Dominance** is a condition in plants where the apex of a leader or branch dominates by preventing the development of lateral branches near the apex. It is controlled by auxin produced at the apical bud. Close to the bud, the auxin

concentration is high and inhibits lateral growth. Removal of the apical bud results in branching near the cut end.

To some extent, the strength of the hormones and the ratio of auxin to cytokinin determines how the tree develops.

- When the apical bud is removed from the end of a branch, the concentration of auxin is reduced. Lateral shoot growth is no longer inhibited by auxin, so one or more buds below the cut will react to the higher ratio of cytokinin to auxin, initiating new lateral shoots.

- Apical growth is strongest (vigor) in vertical shoots (leader or water sprouts). The effect of auxin from the apical bud is gradually reduced the further the branch leans away from the vertical. Sloping branches don't grow as long as vertical branches in one season (reduced vigor). There is little auxin effect in a branch that is bent below the horizontal.

**Fungal Diseases**

Fungal disease is not a death sentence for an old tree over the short term. There are many large old trees that are infected, have survived for decades, and are still strong, vigorous, and produce copious amounts of fruit. In the Pacific Northwest, the most common fungus infection is anthracnose, which causes cankers that damage the bark. In severe cases, it can girdle a branch and kill it. Trees with extensive anthracnose damage can still produce prolific amounts of fruit, so they may be worth keeping and maintaining.

Most of the diseased wood can be removed, and new sprouts will start out fungus-free. Opening up the canopy to light and air will reduce the potential for further infection. Regardless, the practical remedy for the grower is to simply prune away the diseased wood as much as possible during pruning sessions. A further step for control is a spray program to treat the disease.

Pest control and fertilization are not covered here, but there are many resources and specialists available on these topics. One caution is to avoid nitrogen fertilizers for several years after renovation pruning, as it stimulates even more growth.

**Fungal disease.** Even diseased, these 50-100 year old trees are strong and produce fruit

Anthracnose “fiddle string” cankers on apple

No need to remove Burrknot

Old canker, healing process underway, apple

Cankers? on cherry trunk

Canker on bottom of apple branch

**Other Pruning Considerations:**

1. Some growers recommend pruning off no more than 20-30% of the canopy at any one time. But often, a high percentage of the new growth must be removed to prevent a tree from growing larger than desired. Healthy trees are remarkably resilient and can withstand even severe pruning of large branches, without harm.

2. Many beginning growers worry about "over-pruning" the tree. Often, they do the opposite and "under-prune", meaning they don't remove enough of the congested density and older, less productive wood. To maintain equilibrium in a mature tree, the amount of wood pruned off should generally equal the amount of increased growth since the last pruning session. If any area is "over-pruned," it will fill in with new growth in excess of what is needed, requiring normal pruning during the next session. The openness of the canopy in Fig. 7 and Fig. 9 will again look like Fig. 6 and Fig. 8 before the next pruning session.

3. Some growers mistakenly prune off most or all of the new shoots every year, removing the future fruit-producing laterals along with the undesirable shoots, Fig. 13 and Fig. 14, so the tree never reaches its potential for fruit production. Once the pruning error is corrected and new lateral shoots are retained, they will produce fruit after two more growing seasons.

4. Some growers suggest making a precise heading cut just above an outwardly pointing bud. This is important when a tree is young and in the training/shaping phase to direct growth for height and diameter. However, in a mature tree, hundreds of cuts are made, sometimes in hard-to-reach places, and it's not always practical to find and trim at a specific bud. So, a shoot can be trimmed without consideration of how close it is to a bud. Excess new shoots that grow near the cut can be removed during the next pruning session (see Fig. 4 or Fig. 5).

5. Some growers leave a number of water sprouts in the canopy to provide branches with strong apical dominance to draw excess energy. This allows the remaining shoots to develop at a more desirable, less vigorous rate. These sacrificial "lightning rods" can be removed at the end of summer.

6. Moss and lichen are common on trees in the Pacific Northwest, are not harmful, and don't need to be removed.

**Cultural Best Practices:**

- If disease is detected, consider pruning it off.
- Make slanting cuts on major limbs so water runs off, minimizing future rot.
- Remove all cut wood from the orchard and burn diseased wood.
- Periodically sterilize tools, especially after pruning a diseased tree, with 70% alcohol or Lysol (bleach will corrode steel tools).
- Moss and lichens are not harmful; leave them alone.
- The current industry practice is to leave pruning wounds open—do not paint them or apply tree-wound seal.

**Safety Considerations:**

- Do not use a chainsaw in close quarters. Kickback is inevitable and can cause serious injury.
- A cordless Sawzall is a safer option than a chainsaw and can be operated with one hand.
- Use a ladder rather than climbing the tree. Orchard ladders are safer than extension ladders or step ladders due to their wide stance.
- If climbing higher in a tree, use a harness and safety line.
- Use a long-reach pruner to reduce the need for a ladder.
- Wear safety glasses. Branches cut at a 45-degree angle at the tip will invariably poke you somewhere. A hat with a visor (or hard hat) is useful for the same reason.
- Work with a buddy so there are two of you on-site.
- Stop working when you're tired.

**Terminology:**

**Apical bud, Terminal bud**: The prominent bud at a shoot tip or leader that grows first and fastest.

**Bud scar**: A ring on a branch marking where the terminal bud begins growing after the dormant season.

**Canker**: A diseased area of the bark caused by fungal infection.

**Fruit bud**: Fuzzy and resembles the pointed end of a football. Produces blossoms and fruit starting on 2-year wood in the third growing season.

**Fruit spur**: A short branch growing from a lateral branch, tipped with a fruit bud. Adds a small amount of growth each year, giving it a wrinkled appearance. Highly productive for 4-6 years before tapering off.

**Lateral**: A fruit-producing branch.

**Pruning cuts**:

- **Thinning cut**: Removes the entire shoot or branch back to its base.
- **Heading cut**: Removes a portion of the shoot or branch length, halting future elongation and stiffening the branch.
- **Renewal cut**: Removes older wood to make room for new wood with higher fruit production.

**Sail**: An old waterspout that has grown tall (15-20'+), resembling a separate tree on top of a structural limb. May cause structural overload due to wind or snow/icing conditions.

**Scaffold and secondary scaffold branches**: Form the framework to support the laterals.

**Second Flush**: Regrowth of a new shoot after summer pruning, occurring from a vegetative bud near the end of the heading cut on a new shoot after the apical bud has been pruned off.

**Stages of Shoot Development**:

- **New shoot**: Vegetative growth originating from a bud in the first growing season, developing mainly vegetative buds at the leaf nodes by the end of the season.
- **1-year wood**: Branches from the beginning of the second growing season until the beginning of the third, typically developing fruit buds at the nodes by the end of the second season.
- **2-year wood**: Branches from the beginning of the third growing season, with fruit buds producing blossoms and fruit.

**Structural wood**: The large, main components of a tree, forming the basic shape, such as the trunk of a central leader tree, or the trunk and "arms" of an open center tree. Primary scaffold branches originate from the structural wood.

**Sucker**: An undesirable shoot at the base of the trunk, usually from the rootstock used for grafting. Generally removed during each pruning session.

**Tree shapes**:

- **Open center structure**: Common for mature apple or pear trees, characterized by 4-6 outwardly radiating structural branches instead of a central trunk, resulting in a donut-shaped canopy with a central opening and a nominal height of 8-10 feet.

- **Central leader structure**: Cone-shaped with scaffold branches radiating from a central trunk. Layers of scaffold branches are spaced about 3 feet apart along the trunk and get smaller in diameter higher up the tree.

- **Umbrella trees:** Older trees where the scaffold and lateral branches have grown long and are weeping over to form and umbrella shape.

**Water sprout**: A branch that grows vertically in the canopy and doesn't produce significant fruit. Sometimes referred to in error as a "sucker" or "water spout".

**Vegetative bud**: Develops only on new shoots at each leaf node during the first growing season. They look like scales and hug the branch. Fruit buds develop at these sites during the second growing season.

**Vigor, vigorous**: Refers to the relative number of shoots produced during a growing season and the different rates of growth in the new shoots. Vigorous growth produces many new, longer shoots. Standard trees (full size) have a much larger root system than dwarf/semi-dwarf trees, resulting in more vigorous growth.

## References and Useful Links :

These qualified references go into great detail on their given topics. Unfortunately, they sometimes contradict each other. Push "control" and then click on the link to access YouTube videos or the document.

**For Annual Maintenance Pruning:**

BBC Gardener's World Magazine, YouTube:
How to PRUNE APPLE TREES in summer for MORE FRUIT | David's apple pruning guide

How to Prune Apple and Pear Trees in Winter | BBC Gardeners World Magazine

Master gardeners, YouTube: Summer Pruning an Apple Tree to Thwart Excess Vigor

Master Gardeners, Excellent, comprehensive: Pruning Fruit Trees - UC Master Gardener Program of Alameda County (ucanr.edu)

Michigan St University: addresses tip bearers. Click pruning for apples - Apples

North Cumbria Orchard Group, UK, addresses tip bearers:
pruning_tip_bearing_apple_trees_02.pdf

OSU- Excellent, comprehensive: Tree pruning basics | OSU Extension Service (oregonstate.edu)

Orin Martin, UC Santa Cruz Center for Agroecology:

YouTube: The IMPORTANCE of Summer Pruning an Apple Tree - Part 1 of 2

YouTube: The IMPORTANCE of Summer Pruning an Apple Tree - Part 2 of 2

Royal Horticultural Society (RHS):

Apples and pears: winter pruning / RHS Gardening

Winter pruning apples and pears / RHS

University of Missouri: Leaf to Fruit Ratios: A Balancing Act for Sustained Apple Production // Missouri Environment and Garden News Article // Integrated Pest Management, University of Missouri

WSU: Apple Anthracnose | WSU Tree Fruit | Washington State University

Pruning Tree Fruit – The Basics | Western Washington Tree Fruit & Alternative Fruits | Washington State University Gary Moulton, Jacky King

Pruning and Training Systems | WSU Tree Fruit | Washington State University

**For Renovation Pruning:**

Michigan St. University. Excellent video of renovation pruning on a badly overgrown tree, lots of wood removed, height reduction, thinning. Pruned in March with follow-up the next March.

Initial renovation pruning: Renovation Pruning an Old Apple Tree - YouTube

Results and maintenance pruning one year later: Apple Renovation - 1st Year Follow Up Pruning - YouTube

Michigan St. University. Good text description of extreme pruning for renovations: Renovating Old Apple Trees - Fedco Trees (fedcoseeds.com)

Gary Heilig. Large, moderately overgrown apple tree. Good description of concepts and demo. Leaves the tree taller. How to Prune A Really Neglected Apple Tree - YouTube

Lonely Pines. Good on principles, uses cordless Sawzall. Leaves the tree taller: How to Prune an Overgrown Fruit Tree | Neglected Apple Tree Pruning - YouTube

Grow to learn. Removes tall sails, opens up center, good result How to Prune A Really Neglected Apple Tree, How to Prune an Apple Tree!, How to prune an old tree, - YouTube

Waardenburg Family Farm. Smaller, moderately overgrown, good result: Pruning the Old Apple Tree - YouTube

Stephen Hayes is a veteran UK orchardist. Has 10+ years of YT videos dealing with all aspects of apple trees and orcharding. A valuable resource.

> Stephen Hayes- Excellent. Shows 50 yr old tree just after removal of all major wood in early March, with extensive new vigorous shoots ~4 months later in late June for grafting. Apple tree graft over follow up - YouTube
>
> Stephen Hayes- He cut off the tree at the trunk in winter. Shows strong growth in August for grafting: Working over apple trees, result of brutal pruning - YouTube

Alan is a veteran arborist and has some sage advice on renovations on this forum thread: Pruning Old Apple Trees - General Fruit Growing - Growing Fruit

OSU, good for new and renovation. Includes umbrella trees: Training and Pruning Your Home Orchard | OSU Extension Service (oregonstate.edu)

**Tree Physiology**

Auxins and Cytokinins - What's the difference? | How do they work? - Southside Plants

Spreading shoots of young apple trees | Good Fruit Grower

Tree Fruit Lakso (cornell.edu)

Why apples need both spur and shoot leaves to grow (treefruit.com.au)

**Fungus, disease and pest info**

WSU, description of common diseases and pests:

> hortsense.cahnrs.wsu.edu/Search/MainMenuWithFactSheet.aspx?CategoryId=3&PlantDefId=59&ProblemId=16

WSU, anthracnose description: Apple Anthracnose | WSU Tree Fruit | Washington State University

WSU Extension Publications|Anthracnose Canker Integrated Management Plan for Home Gardeners (Home Garden Series)

WSU, powdery mildew description: Apple Powdery Mildew | WSU Tree Fruit | Washington State University

Video: How to Identify and Remove Canker from Apple Trees - YouTube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