Forest Management for Small Landowners

Tree Growth

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33 year old Douglas-fir stand

Introduction

Like the other chapters in this series, this one is written for the small forest landowner who knows very little about tree growth and physiology. Because I am not a tree physiologist, I asked two friends who are experts to assist. Dr. Bill Carlson provided the Tree Physiology section and Dr. Gary A Ritchie the Dormancy section, plus both of them contributed to other sections. If you want additional details, I highly recommend the book "Inside Plants", by Gary A. Ritchie, PhD. (*It can be ordered from all the major book stores.*) Learning how trees grow will help you better understand what is happening on your tree farm, and how your actions can affect growth and marketability of your future crop.

Tree Growth

Tree Physiology in Brief

"Trees grow by making more cells. Cells are made in apical meristems in buds which contribute to lengthening the main shoot and the branches and also produce needles. Diameter growth takes place in another meristem called the vascular cambium. The vascular cambium is very critical to forestry production. It produces sugar conducting phloem cells to the outside, just under the bark, and water conducting xylem tissue (*wood*) to the inside. The phloem transports sugar produced by photosynthesis in the leaves down the tree and throughout the roots. The wood (*xylem*) conducts water up the tree. Water loss from the leaves to the air causes water to be pulled in a continuous stream from the soil to the roots then up through the main stem and out to the leaves and finally into the air. Nutrients from the soil are carried up through the tree in the water stream."

"Leaves have regulatable holes on the underside called stomata. On a Douglas-fir needle the light colored lines on the bottom of the needle are lines of stomata. When these pores are open, carbon dioxide from the air enters the inside spaces of the needle and while this is going on water leaks out."

"Energy in the tree comes from photosynthesis. This takes place in green chlorophyll containing cells in the leaves and young shoots. The chemical reactions of photosynthesis require sunlight, carbon dioxide and water. Oxygen is released in the process. In photosynthesis the energy from sunlight is converted to sugars which can be transported throughout the tree in the phloem to support cell production and to maintain the living cells through respiration. Sugars are basically energy and carbon storage devices. They can be assembled into more complex forms and broken down again to provide energy and carbon. Production of new cells in the meristems and maintaining a life in the trees' living tissues all depend on energy and carbon from those sugars."

"In the lowlands of the Pacific Northwest most of the time temperatures are suitable for active photosynthesis all through the fall and winter as well as in the warmer seasons. It is usually above freezing and a bright overcast day has enough light to support very active photosynthesis in Douglas-fir. That doesn't mean active growth continues all winter." *Courtesy Bill Carlson, PhD, Senior (Ret.) Forest Research Scientist, Weyerhaeuser Company.*

A Year's Growth Cycle

Dormancy

"Entrance into dormancy slowly begins in late summer triggered by shortening days (*see Figure 2.1*). Here in Washington, the peak of dormancy occurs around November. Dormancy is gradually released over winter as the plants are exposed to temperatures in the range of about 35˚F to 45˚F. Dormancy is fully released by late February, at which time warm spring temperatures (50˚-60˚F) cause the buds to swell and break and shoot growth to begin. Root systems do not have a 'dormancy cycle' but rather, grow when the temperature and soil moisture are adequate. This is evidenced by high root growth potential (RGP) of seedlings tested in winter when the tops are dormant. Root growth is very sensitive to soil temperature and ceases when temperature drops below about 45˚F". *Courtesy Gary A. Ritchie, PhD, Senior Scientist (Ret.), Weyerhaeuser Company.*

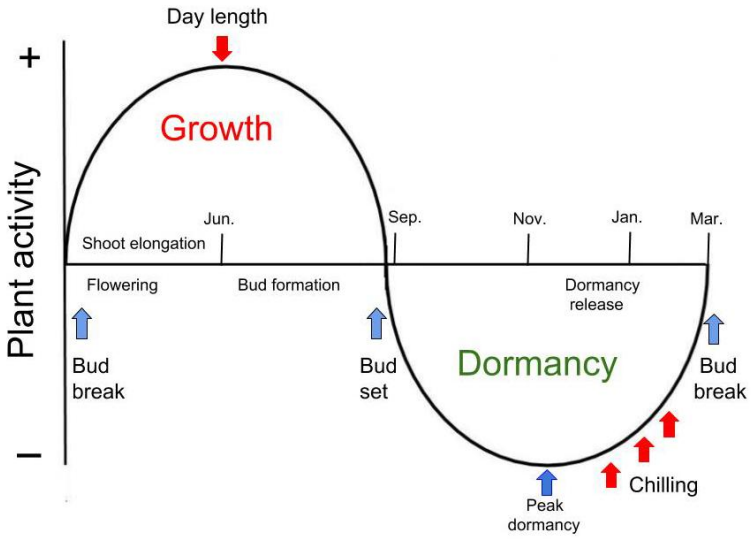


Figure 2.1 Courtesy G. A. Ritchie

Spring & Early Summer

"Growth of Douglas-fir begins in the spring with diameter growth generally starting in late March (*shown using electronic dendrometers*) and height growth in May. These phenological events are controlled by environmental conditions. The triggers of spring growth and flowering are based on air temperature – not just the current air temperature but the accumulation of past temperatures known as chilling hours and forcing hours. The more chilling (*temperatures just above chilling are the most effective*) a tree receives, the lower amount of forcing (*warm temperatures to promote cell expansion and division*) is needed to result in budburst. The relationship between chilling and forcing has been described as a "possibility line" as it separates combinations of chilling and forcing that can result in budburst from combinations where budburst is not

possible. Each tissue (*in vegetative or reproductive buds or in the cambium*) has a different possibility line and genotypes may differ in their lines. During the spring and summer, plants will continue to grow as long as soil moisture and air temperature permit. Height growth is sometimes considered to be the extension of the leaf and stem sections present in the overwintered bud but that is generally NOT true!! The apical meristem continues to produce more primordia as long as all conditions (*photoperiod, moisture, and temperature*) are not limiting. The only time when height growth is limited by the structures present in the overwintered bud is during seedling establishment. Once the root system is well established, the tree will switch from predetermined shoot growth (*extending structures from the overwintered bud*) into continuous growth". *Courtesy Bill Carlson*

If you could look inside the buds from early spring to late summer, you would see a compressed view of the next terminal, lateral limb, or branchlet. As the sap reaches the buds, the individual cells begin to multiply and swell. We see the result of this as the terminal, branch, and branchlets begin to elongate. Most Douglas-fir plantation seedlings will have at least 2 inches of height growth by early May. (*In western Washington this will vary by 2-3 weeks.*) This elongation growth lasts about 4 months from March through June (*will vary in different areas*) and will vary by the weather and primordial development.

In the case of the terminal growth, the elongation growth is visible first, followed by a period of individual cell wall thickening which will cause the terminal of a Douglas-fir to go from a bent over position to one more vertical in shape. This process generally starts at the base and progresses up the terminal.

Normal early spring growth on Douglas-fir

Cell walls begin to thicken from the base and straighten the stem from the base upward

Grass grows from the base of the plant, so when it is mowed the cut end rises in height when the grass grows. Tree height growth takes place at the branch tips. A scar on the tree trunk at 4 feet from the ground will be in the same place 50 years later.

Late Summer and Early Fall

Tree height growth and lateral limb growth ends in early to mid-summer. After the height growth stops, the tree continues to put on diameter growth until declining air temperature and photoperiod slows its growth in fall. Root growth is more temperature related and can start up and stop during winter warm periods. When you look at the two different colors of the yearly diameter growth in the rings of a piece of wood, notice the lighter color and wider growth that is formed during the summer and the darker latewood that is put on in the late summer and early fall. *See Figure 2.2.*

Near the end of summer the tree begins to transport the majority of the produced food down the stem into the roots for both fall root growth and storage for the next spring growth cycle.

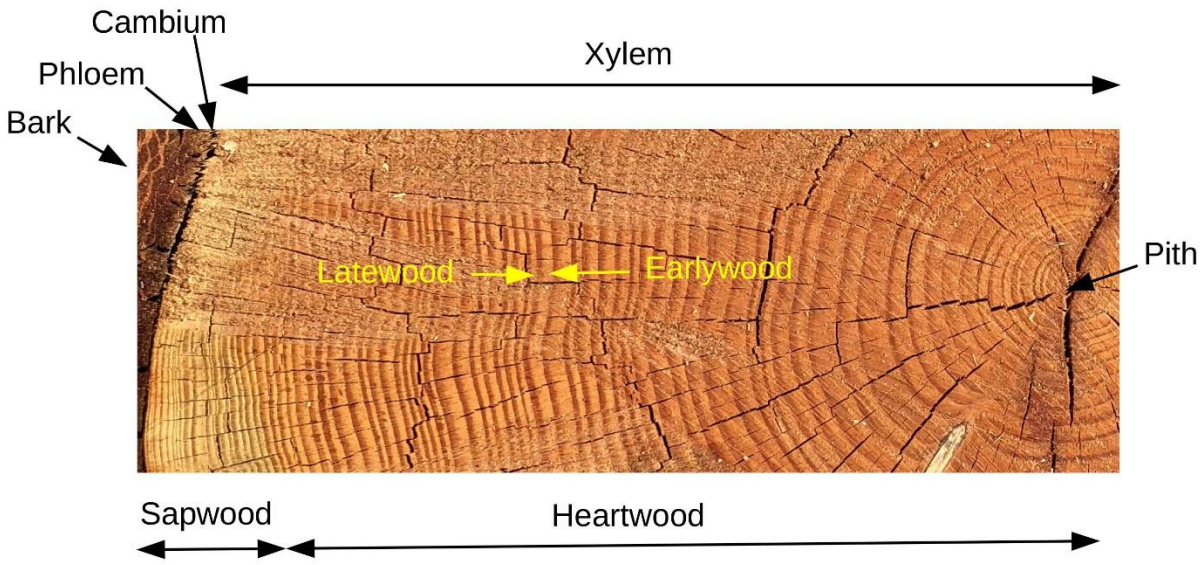


Figure 2.2. *Courtesy G.A. Ritchie*

Stand Development

Sinuosity

The word “sinuous” describes the way a snake moves along the ground. Tree growth can be sinuous in the terminal and also in the lateral branches.

- In the majority of trees you observe, it is likely that the cause is genetic, especially when both the terminal and lateral branches of a tree show the symptoms.
  - On the other hand, the environment may be a factor when it is observed in very high site land and along coastal areas or areas of heavy rain fall. (*This may just be a case of the environmental effects increasing the genetic effects.*)
  - Some scientists feel it may be due to the extra weight of rain and/or dew causing the terminal to bend over at too great of an angle for it to recover with normal cell wall thickening.

The science behind sinuosity is complicated and more involved than we can go in to here. In general:

- Genetics is the most likely cause of sinuosity.
- Slower growing trees on low site land do not seem to be as susceptible to sinuosity as faster growing trees on high site land.

Sinuosity

If you are interested in more information, these two research reports may be of interest.

- "Is long primary growth associated with stem sinuosity in Douglas-fir?" Canadian Journal of Forest Research 36:2351-2356. 2006. Barbara L. Gartner and G.R. Johnson.
  - Summary: The rate of stem growth was not a large factor in determining whether leaders become sinuous.
- "Sinuous stem growth in a Douglas-fir (*Pseudotsuga menziesii*) plantation: growth patterns and wood quality effects." Canadian Journal of Forest Research 30:761-768. 2000. R. Spicer, B.L. Gartner, and R.L. Darbyshire. Summary:
  - Trees with a highly sinuous leader at age 12 were more likely to be sinuous in later years.
  - 25 year old trees with sinuous growth were bisected and wood near the pith was found to have more compression wood than normal.

Early spring growth that may turn in to sinuosity.
(Netting and stake are for deer protection.)

Ramicorn Branching and Schoolmarms

Ramicorn branches grow at a high angle from the bole of a tree, rather than the horizontal or slight upward angle of a normal branch. They are often called "spike knots" because when the log is cut into lumber the knot is oblique (*long spike shape*) instead of round.

High angle or ramicorn branch

Lammas growth, may become schoolmarm

Schoolmarms are often caused from the same environmental factors that produce ramicorn branches. However schoolmarms are two terminal branches that continue to live and compete with each other.

Environmental and Genetic Causes

Ramicorn branches and schoolmarms can result from environmental or genetic causes or a combination of the two. Both are generally from what is called lammas growth or second flush.

Four environmental factors can have an impact on lammas growth.

- Rainfall in the early summer, after the buds have set, can cause the buds to become active and begin a second flush of growth.
- If the water table at a site is high enough (but *not so high as to slow growth*) that the seedling roots can tap into it, they may have sufficient water to develop a second flush.
- Animal browse (like elk and deer) can cause multiple tops to develop and compete for dominance. The outcome is either a series of ramicorn branches (spike knots), or multiple tops (schoolmarms).
- Heat and cold can cause problems such as the above.

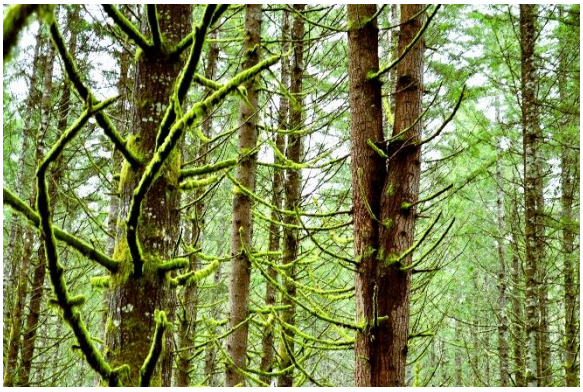
Because the lammas growth takes place in the mid- to late summer, the shorter days with less available light means there is not sufficient time for the new growth to develop its potential height. The terminal and lateral buds near it will grow only 1-12 inches in length and the terminal does not have time to develop terminal dominance. The following growing season, multiple branches at the top of the tree will compete for the terminal position. One may win, leaving potential ramicorn branches, or two may continue to grow side by side and create a schoolmarm (*two terminals*).

Genetics can also play a role. In a proprietary test on the industrial tree farm I managed as a young forester, rows of 25 genetically-identical trees were planted. If a tree had a ramicorn branch at 15 feet, then every tree in the genetically-identical row had an identical ramicorn branch! It was amazing to see what had been long suspected right before our eyes. This lends credibility to ramicorn branching being a genetic trait.

What no-one may ever know is just how much the two work together. If a tree has the genetic potential to do a second flush, then what impact does the rain or the ground water play on it actually happening?

Log Quality Damage

- The schoolmarm issue is much worse than ramicorn branching because it usually results in a lost tree just before harvest time. When the tree is young, the two tops do not seem to put too much stress on the joining seam. It would seem logical that the landowner could salvage two smaller tops and not have a total loss. However, my experience has been that between 25 and 35 years of age, one of the tops will break out in a winter storm. Then in a few short years, the exposed wood of the former schoolmarm joint begins to rot and the second top is blown out. A short time later the entire tree is too rotten to make a merchantable log. Personally I would rogue out schoolmarm trees in a thinning operation as my number one priority!!!



Double top or schoolmarm

Former double top

- If at harvest time, logs of sufficient length can be manufactured from either side of the ramicorn branch, then the scaler usually just gives a length deduction. If you are selling long logs then this can usually be done. However if you are selling short logs, there may not be sufficient room on either side of the ramicorn branch for a merchantable log. The ramicorn branch will leave an oblique knot or

Ramicorn branch or spike knot

spike knot (*looks a like pointed spike*) in the lumber. It can cover the entire width of a 2 x 4 or 2 x 6 and will be a weak spot on the board.

Options

- Some plantation trees will break bud much earlier than others. Because these trees have had more time to develop and to set the next year's buds, they are most likely the trees that will also break bud with a mid-summer lammas growth. To my knowledge there have been no studies on this, but it has been long suspected to be true. So there are two things you can do that may or may not have an impact on ramicorn branching and schoolmarm development.
    - If you are doing a spring spot spray, you might want to also spray the planted conifers that are breaking bud early, especially if you can treat trees that are too close together. Without a long-term study, you will never know if this works.
    - If you are doing a PCT thinning the same will hold true. Try to cut those trees that are breaking bud early and show evidence of ramicorn branching. One disadvantage of doing this is the trees that break bud early are likely experiencing a longer growing season and thus are your larger leave trees!
- A second option is to try planting stock from a higher elevation zone because it will break bud later than local trees around your site. Don't get carried away with this and plant something 1,500 feet higher than your site. A lot of the stock available is now genetically improved and none may be available that is 500 feet higher elevation. To my knowledge this has also not been studied but is something I have noticed and believe to be true.

Crown Effects on Tree Taper

Tree with 100% live crown

A tree growing in the middle of an open field will have branches growing all the way to the ground because there is plenty of light for them. Because of all these branches and needles, it will be growing at a maximum rate and will be very truncated (lots of taper). Some species grow more truncated than others but generally an open grown tree will be heavily truncated. This is not what we are trying to raise as timber because the mills don't want logs with lots of taper and large knots caused by the large limbs.

Open-grown Sequoia with a lots of taper

Tree with 10% live crown

A tree raised in a very overstocked but uniformly spaced stand may have as little as 10% live crown. Because there are so many trees, the lower branches will have all died off and the stems will be very cylindrical (very little taper). This is the reverse of the previous example. But because there is so little active crown to produce the food for the tree, they will be growing slowly. Mills will take these trees and be very happy, but you have not maximized the growth potential of your site.

35 year old Douglas-fir stand with little taper

These are both extreme examples of tree growth and not how you want to manage your timber. Remember: The ability for the seedling/tree to grow is dependent on the health and number of needles it has!

What is the Most Desirable Amount of Live Crown?

30% is often quoted as the perfect amount of live crown that will allow the stand of trees to utilize light and moisture and produce the maximum amount of wood. Realistically something between 30% and 50% will serve most landowners. 30% live crown will give the landowner a blend of log quality and maximum stand growth. 50% is acceptable for a more openly-grown stand that will sacrifice some log quality for higher growth rate. Remember that a stand of trees is constantly changing, both from the trees around it and the management practices we conduct on the stand.

Effect of Soil and Spacing on Tree Growth

For the most part tree height is a function of soil quality. We rate soil productivity by how tall a tree can grow in 50, or in some cases 100 years. For example, Douglas-fir will grow 135–140 feet tall in 50 years on the very best soils (*called Site 1)* but only 74 feet or less on the poorest soils (*called Site 5*). A very rich river bottom soil will consistently produce trees of the same height year after year once the trees are beyond the seedling and juvenile growth stages. The same trees growing on rocky soils with low fertility may produce trees only half as tall.

Diameter is more of a spacing issue. The closed stand with lots of stems per acre mentioned earlier will have very few live branches and a very small crown. As a stand grows, the branches of the individual trees begin to overlap (*crown closure*). The lower branches begin to die and ultimately the woody branch itself will fall off the tree, allowing the tree to put on clear (*knot free*) wood. How fast this process takes place depends on the average tree spacing. When a tree has very few live branches, it also has very few needles which are the factories that produce food for growth. Diameter growth is lost

when the factory is reduced. On the other hand, an open-grown tree on very high quality ground can have large diameter growth on the stem and branches.

Reaction Wood

Forest landowners will often take logs from their property to be sawn on portable sawmills that they or others own. If you do this, be sure to watch out for logs showing signs of reaction wood because it will make very poor lumber.

Reaction wood is a general term for wood that forms in parts of leaning or crooked stems and on the lower sides of branches. It tends to return to the original position when sawn.

In conifers, it is referred to as compression wood. Anatomically the cells are different and the zones of the compression wood will be darker in color than surrounding wood. When cut into lumber, it will often split and crack.

In hardwoods it is usually referred to as tension wood and it has abnormally high longitudinal shrinkage, tending to cause distortion and splitting when cut into lumber. Usually it is darker in color, has more cellulose, and less lignin and produces weaker paper.

Juvenile Versus Mature Wood

- Juvenile wood is the core wood of a tree trunk, starting at the ground and progressing up the tree to the top. There is no fixed age when it ends and one cannot tell by looking at a cross section where one ends and the other begins, but 20 years is an average in Douglas-fir. Lumber cut from juvenile wood will have the following characteristics.
    - It has a lower specific gravity than mature wood.
    - It will not withstand the bending test of structural grade wood.
    - It has more warp and twist when made into wood products.
    - Overall it is a lower quality wood.
- Mature wood is everything the tree grows outside that juvenile-mature boundary.
    - It is a higher quality wood.
    - It does not exhibit as many defective characteristics as the juvenile wood.
    - It has a higher specific gravity.
    - Mature wood is high-quality construction wood for beams and dimensional lumber.
    - And mature wood easily meets the bending and breakage testing of structural grade wood.

Scarred Trees

"Trees seal, humans heal" is a common saying among foresters. If you cut yourself, the tissue on both sides of the cut will either heal together or produce scar tissue between the sides. On the other hand, trees will seal over a scar, cut, or damaged area. A large slab of missing bark (*like what is caused by equipment damage*) will form new tissue all around the edges from the adjacent live tissue. This ultimately will seal over the damaged area, leaving the scarred wood in it isolated behind the growth that covers it. Surveyors used to blaze trees and write on the exposed wood to indicate the distance to a property corner. Many years later foresters would find the tree and physically cut the sealed area from the tree, exposing the former surveyor's writing.

Branch was split by snow. 10 years later the sealing is almost done

Pruned fruit tree branch. 5 years later, sealing is 30% complete

Mechanical damage such as a falling tree rubbing against another tree, or equipment bumping a tree and leaving a scar can cause a lot of heartache for the tree farmer. Fungal spores are in the air almost all the time and everywhere in the Pacific Northwest! These spores will invade the tree through the damaged wood and begin to break down the wood cells and ultimately lead to rot in those cells. A tree damaged near the root line will, in 10 years, have a column of rot going up the tree trunk for plus or minus 10 feet. The same scar in a hemlock along the coast will lead to rapid decay that is so fast and destructive that the tree becomes non-merchantable in a few years.

Butt log has soft punky rot. Rot continues up log. Circled rot in 2nd log is at 5 feet.

Circled rot is at 10 feet on tree trunk, diminished in size but still continuing up the trunk

Pruned Trees

Pruned stand

In a sense, a pruned tree is also a scarred tree, just with a smaller scar. Many times landowners will want to paint or coat some kind of sealer on the cut or scarred surface to protect the tree. However it is not necessary, and can even be detrimental, especially on small scars. There are two ways the tree can heal itself from pruning or injury.

- In the spring the sugary sap will flow from a pruned branch. Don't worry, as the sap is one way the tree is able to prevent pathogens from entering it and causing infections.
- The rest of the year the tree will form a lignin-dense callus over the wound which will keep insects and microbes from invading the site. When the wound is painted, the paint tends to block the trees natural defensive mechanisms!

Sunscald

Sunscald with well-defined live and dead tissue

Any action you take in the first 20 years on a tree or a stand of trees that exposes the south, southwest, or west exposure of the tree to direct sunlight, will most often result in sunscald, and may lead to death of the seedling or tree. Sunscald takes place when the lateral branches are cut, exposing the thin bark to very hot sun and especially the sun of the late afternoon. It can also happen on rapidly growing trees that have a long gap between branch whorls. The original injury is very similar to our being in the sun for too long and getting sunburned. However after that the injury differs because of the slogan mentioned earlier - "humans heal – trees seal". A tree does not heal like a human, so over a period of years, the damaged cambium (*which lies right behind the damaged bark*) actually dies. Your first indication of this is to see a slight red tinge to the bark on the southwest quadrant. Over time it develops into a darker red color and then because there is no live tissue behind it, begins to look an unhealthy dead-like color. Up until this point many people will think the tree will recover, but it never happens. Ultimately the bark cracks and begins to sluff

Sunscald with open wound and with live tissue growing around the dead area

off the tree. If the sunscald is limited to a small area, then the tree's live tissue on either side of the dead area will begin to grow around it to seal the wound. This takes from 5-10 years depending on the severity of the wound. In extreme cases (*especially on smaller trees*) death of the tree will be the final result. At the very least the tree will have a large sealed-over wound that will need to be long bucked (*cutting an unusually long section off the butt log due to some kind of defect*) at harvest time.

When Do Environmental Conditions Cause Trees To Stop Growing?

The following is taken from Science Findings, October 2018, USDA Forest Service, Pacific Northwest Station, describing research by Dr. Connie Harrington, Dr. Brad St. Clair and Dr. Kevin Ford.

The authors studied Douglas-fir trees on a very warm site in southern Oregon in 2015, in the midst of a very dry period, during 100 degree Fahrenheit days, and coinciding with the summer solstice. They found that trees stopped growing for the remainder of the summer (*due to the heat and drought conditions*).

- Earlywood (*early summer diameter wood*) transports most of the water within trees when moisture stress is low (*spring and early summer*).
- Latewood *(late summer and fall*) has smaller cells and a narrower water column, so it is easier to maintain the water flow to the crown. If the trees stop growing before the latewood is laid down, they will be more susceptible to top and limb dieback, and even **possible** mortality.

Another form of growth stoppage is in tree top die-back. This will likely happen when the above described situation is taking place. Remember from the Tree Physiology section: "The wood (xylem) conducts water up the tree. Water loss from the leaves to the air causes water to be pulled in a continuous stream from the soil to the roots then up through the main stem and out to the leaves and finally into the air. Nutrients from the soil are carried up through the tree in the water stream." (*Courtesy Bill Carlson*

That stream of water is microscopic in diameter and in an extreme heat period it can be broken. Once it is broken it can never re-establish itself. The tree can develop new lateral branches that may try to grow upward and possibly become new terminals but if the event happened where the tree bole was 3 inches in diameter, then for many years there is a dead top from the 3 inch diameter bole to the top of the dead stem.

Douglas-fir top dieback caused by drought. Courtesy G.A. Ritchie

Personal Experience from Summer of 2021 - Extreme Heat Damage

On June 25 – 27, 2021 all of Washington was warned by a heat wave, with expected temperatures of over 100˚ Fahrenheit. Over the three days in our area (*Lewis County*), we experience temperatures in the range of 110˚ - to a high of 115˚ on one of the days. It very uniformly covered all western Washington with some areas like the coastal zones suffering higher damage than inland areas. It was so uniform that shaded areas under a forested stand were close to the same temperatures as out in the sun!

We first noticed Douglas-fir damage to the needles within a week, and the loss seemed to come in at least two waves. The first was within one week of the high temperatures, these needles ultimately fell off the limbs. A later needle loss followed about a month later (*timing is approximate*). All the damage we saw seemed to be worse on the south and west sides of the seedlings. Over the remainder of the summer, we noticed the following:

Needle burn

- On all previous year's growth and in some cases on current year's growth
- Any reflective surface near the trees (*rocked road, pavement, and bare ground*) would generate some of the most severe damage on the surface facing the reflective objects.
- Greatest consistent level of damage was to late afternoon sun from the west and a southerly exposure.
- For the Douglas-fir and hemlock, most of these needles dropped off over the following few weeks – some at end of summer. Many of the spruce, noble fir, and pines held their needles until fall winds and in some case until late winter.
- Off-site species such as noble fir were hit hardest. Noble fir likes high elevation, lots of moisture in the form of rain or mist, year round, but does not like its feet to stand in water and does not like clay soil. In low elevation Western Washington, we already experience all 4 of these factors, so when the heat wave arrived, it really did a lot of damage to the young noble fir. When you plant an off-site species, you are hoping that your weather and climate conditions will be suitable for that species. In many cases the young seedling will die soon. In other cases, it may take something like the heat wave we experience to kill the tree or severely damage its growth potential.

Terminal Growth

- Trees stopped terminal growth during the heat wave, and for the remainder of the growing season.
- Lamma's growth visually stopped at whatever point the tree was at in its development. If terminals were still bent over at the time of the heat wave, they stayed bent over for the rest of the summer.

Sunscald

Sunscald was an issue, especially on seedling terminal growth or anywhere along the trunk of the tree that did not have adequate branch and needle

protection. This was in the form of very small 1/8 -1 inch sunscald scars, to long sections of 6-12 inches running up and down the young terminals.

In some cases, the previous year's sunscald damage was enhanced by the one foot of snow we received the first winter after the heat wave.

Mortality

Some of the seedling mortality did not occur until the end of summer – on those heavily damaged trees with south to west heavy needle damage. These trees originally appeared with varying degrees of needle death. Then toward the end of summer the needle color became an off-green color, until by mid-October the needles were obviously dying. Many of these the trees died (*especially the younger trees*) a short time later.

Mature Trees

Damage to the mature stands was a little more difficult to see when trying to look closely at bud and terminal growth 100 plus feet over our heads. Some of the items we think we noticed include:

- There appeared to be less terminal growth, but that is hard to quantify as most of the terminal growth was over when the heat wave started.
- There seemed to be more trees with top kill from the breaking of the water column during the high temperatures.

I talked to Connie Harrington one of the authors of the previous report on tree growth losses during high temperatures and she confirmed that she and her colleges were finding the same types of damage in other areas and yes, the trees had also stopped diameter growth during the heat wave.

4 growing seasons later, the damage was very difficult to see. The trees had put on 3 years of growth, and none of the needles of the heat wave era were still on the tree, and those that died were not that noticeable.

Lower Limbs Rot and Fall Off the Trunk

Western Washington and Oregon are known for their heavy rainfall. With the rain and moderate climate provided by the Pacific Ocean, an abundance of fungal spores are in the air at all times. To test this out just place some fresh cider in a dish and leave it on the counter; it will turn to vinegar very soon. Or mix flour and water in a dish and leave it on the counter. In a couple days it will start to bubble (*ferment*) and you will have started sourdough!

Due to the high humidity weather and the constant supply of fungal spores in the air, a tree limb that has died from lack of light will be unable to fight off the fungal attack like a healthy limb can. The fungus begins the process of rot by invading the limb with microscopic mycelia strands. Eventually the limb falls off and the tree seals over the

stub wound. If the limb is small and the tree healthy, in a few years the sealed over portion will just blend into the bark.

I noticed something interesting on a forestry trip to New Zealand in the early 1990s. All of their commercial forests are of introduced species that are not native to New Zealand. Since New Zealand is an island a long way from a large land mass, it has very few fungal spores that attack the non-native species. As a result, the tree limbs still die back when shade cuts off the growth, but they continue to hang on until the tree is harvested. It makes walking through the woods much more difficult than in the Pacific Northwest.

The photo below came from a 35 year old Douglas-fir stand on the South Island. It already had more merchantable wood per acre than we can produce in 50 years in the Pacific Northwest. The most striking thing about the stand was the dead limbs still hanging on. They reminded me of dead hemlock limbs on in overstocked stand. Instead of rotting off the stem they hung on and poked and scratched our faces!

For additional information, see *Inside plants: a gardeners' guide to plant anatomy and physiology,* by Gary A. Ritchie, PhD.

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35-year-old Douglas-fir in New Zealand