International Journal of Research in Engineering, Science and Management
Volume 7, Issue 6, June 2024
https://www.ijresm.com | ISSN (Online): 2581-5792

The Life Cycle of a Tree

Divine Matey*
General Manager, Department of Administration, Accra City Hotel, Ghana

***Abstract*: The importance of the tree life cycle is often overlooked by society. One important aspect is the environmental benefits conifers and deciduous trees have to offer. For example, the shade and shelter that a tree provides is home to many different types of wildlife. A tree is also a prominent source of oxygen. People don't always acknowledge the fact that breathing air is using oxygen. Trees act as a filter; they take in carbon dioxide from the air and convert it into oxygen and carbon. The carbon is then used in order to make a food supply for the tree. During this process, conifers and deciduous trees produce enough oxygen in a year to sustain a family of four. Lastly, wood is a renewable resource and it supplies us with many different products. With the information that the essay has related to the tree and its beneficial life cycle, society should consider increasing the knowledge and conservation of trees in order to provide a better environment for the future. Now that you have been informed about the life cycle of a tree, maybe next time you see a tree or a sapling, you will think back about how it all began from a seed and how much that tree benefits us and the environment. In order to identify a tree, it's important to have knowledge of the different leaves each tree has. The life cycle of a tree is what the essay is based around. A tree's life begins with fertilization. Reproductive cells from two parent trees join to form a new seed. Typically, a seed consists of three main parts: the outer seed coat, which protects the seed; the endosperm, which is a food storage for the seed; and the embryo, which will become a new plant. Soon the seed germinates and the embryo grows into a seedling. In order for the seedling to flourish, it needs ample amounts of light and nutrients. The seedling will eventually turn into a sapling and a young tree. Time is needed in order for a mature tree to form. Usually, when a tree is fully matured, it will bear seeds and the cycle begins again. Every species of tree has a predetermined time span which is genetically programmed. This time span is the maximum age a tree can live under ideal conditions. A tree is defined as a perennial woody plant with roots, having a single stem or trunk unbranched for some distance above the ground, and a head of branches and/or foliage. There are around 2,600 different types of trees. They can be divided into two categories: coniferous and deciduous. A coniferous tree has seed-bearing cones and needle-like leaves. Conifers are also known as softwoods. Examples of conifers are pine, fir, and cedar trees. A deciduous tree has fruit and/or seed-bearing flowers and its seed is enclosed. Deciduous trees lose their leaves at the end of the growing season. Trees play an important role in our ecosystem by providing wildlife habitats, oxygen, absorbing carbon dioxide, and most importantly, by providing us with paper and other wood-based products. Though trees have always been important to us, how much do we really know about them, especially their life cycle? This essay will cover the topics of what a tree is, the types of trees, the life cycle of a tree, and the importance of the tree life cycle.**

***Keywords*: Deciduous, Defoliation, Evergreen.**

1. Introduction

Tree life cycles are incredibly interesting and play a fundamental role in the ecology and the sustainability of ecosystems. Tree growth is a complex process that also affects forest succession to an incredible degree. Because of this, we can learn about the history and the future of an ecosystem by studying trees and their life cycles. Unfortunately, the life cycle of a tree is a slow process, and we cannot actually see one tree go through all stages of the cycle. Because of this, observing changes in tree populations over time provides a good approximation of their life cycles. This involves looking at relative numbers of trees of different age classes, as well as different species compositions, and relating these numbers to forest disturbance history. By doing this, we can actually determine the successional dynamics that have occurred and the original causes of such dynamics. We can also identify the future trends in forest development and the possibilities of different management strategies on specific sites. (Davies et al.2021)

A tree is a large woody perennial plant. Ever noticed how a plant that looks like a small tree outside, looks so different when it is full grown inside? Some characteristics of trees are that they have a main liquid trunk, plants or a canopy, lateral branches, and they are usually 3 meters tall. Trees are incredibly amazing living organ systems. They are the largest organism on the planet and provide every living thing with oxygen. Without trees, there could be extreme amounts of pollution and a lack of clean air. Trees also provide food, protection, and homes for many animals, invertebrates, and fungi. All trees have a life cycle, like all organisms do. (Gilhen-Baker et al.2022)

A. Definition of a Tree

Trees differ greatly from other plant species in that their size makes them long lived. Trees typically produce a relatively brief period of reproductive activity, often as little as 3% of their entire life. Competing for a living space requires mechanisms to suppress the growth of neighbouring trees of the same species as well as those of species that might shade them out. Features that help identify a living space where light is available include large, broad leaves and crown shape that suppresses the growth of neighbours. That is, trees often have a shape and form that enables one to determine their competitive strategy in the struggle for light. Other forms of competitive suppression

*Corresponding author: divine.matey@live.com

include the production of chemicals into the soil environment that impedes the growth of other plants, and the actual physical destruction of other trees in a forest via branches or falling stems. Trees have evolved methods to cope with herbivorous predators that might eat their leaves or consume other parts of the tree. As leaves are essential to capture light for photosynthesis, perhaps the most obvious tree adaptations are the various types of chemical and physical defences aimed at herbivores. While herbivory is a natural part of the environment, the introduction of foreign pests from other regions can disrupt and even kill trees unaccustomed to the new predators. This is typically because unlike a mobile animal that can escape a predator, the sedentary nature of trees and the great investment in above-ground and underground biomass make it difficult to withstand damage from attacks on biomass. (Piovesan & Biondi, 2021)

A tree is a perennial plant, meaning it lives for more than two years without having to be replaced. It has a main stem or trunk, which produces branches and leaves. Trees are dominant plants in their ecosystems; they create a majority of the landscape, and the biomass of a tree is often greater than all the other plants in their ecosystem combined. Trees around the world play important roles in the environment, providing oxygen, improving air quality, climate amelioration, conserving water, preserving soil, and supporting wildlife. They also serve as a fuel and building materials in many societies. Trees have a life cycle, like all living organisms; the study of trees and how they develop, the seed, the young plant and eventual adult, give insight to the workings of evolution. (Zhang & Shao, 2021)

B. Importance of Studying Tree Life Cycles

Tree life cycle studies are important in silviculture. It is much easier to follow the fates of seeds and seedlings than of the microscopic spores and gametophytes of ferns, horsetails and fern-allies. Consequently, our understanding of the biology and ecology of trees is much better than that of the other groups and the terms and concepts used in this chapter are generally applicable to seed plants in general. Consequently, a good deal of what we know about the basic population ecology of seed plants comes from work on trees. We also have a lot of tools and techniques for manipulating trees, such as felling and clearing, ring barking, herbiciding, and controlled burning. These are important ways of being able to do experiments at the population and community level, especially at large scales. Controlled burning is currently a very important technique in savanna and woodland conservation and management, so it is important to understand its effects on the post-fire successional dynamics of the ecosystem. Understanding tree life cycles is also essential for modeling forest dynamics and the projection of long-term changes in forest composition and structure, for instance under global climate change. (Vacek et al., 2023)

It is important to study tree life cycles because they are long and diverse. Trees are the primary sources of energy in the form of wood and fuel in the world. A secondary tropical rainforest may contain over thirty species of trees per acre, but only the study of tree life histories can help us understand on what basis this great diversity has evolved. These studies are important as a basis for rainforest conservation and management. (Lu et al.2020)

2. Seed Germination

Seed germination is a vital phase in the life cycle of a tree. For this reason, seeds have developed many strategies for germination. To understand these strategies, it is necessary to appreciate the conditions necessary for germination to occur. Seeds may remain dormant and not germinate until conditions are right. This can be during the wet season when there is enough moisture to supply the seed until it has fully developed into a photosynthesizing plant. Alternatively, the seed may wait until it receives a signal that it has been buried in the soil (as would be the case if a canopy seed were to be dislodged and buried by a fallen tree). Seeds usually germinate when the soil or substrate is moist or when seeds are provided with an adequate water supply. This is because imbibing (the taking up of water) is the first step in germination and is necessary for all subsequent growth and development. Most species of trees have other specific requirements for germination which may be broken down into a specific temperature range; fire (several Australian species only germinate after being burnt); light requirements and the presence of certain chemicals or plant growth regulators in the surrounding environment.

The sequence is initiated by imbibition of water through the seed coat. This causes the seed to swell and may crack the seed coat. Imbibition increases the metabolic processes within the seed and prepares for growth. If the environment is too dry, germination will not proceed. This is because metabolic activity requires an aqueous environment, and dry conditions favor dissipation of the stored food supply. High or low temperatures can be responsible for dormancy breaking in seeds. A suitable temperature range usually allows germination to proceed. However, some seeds require a period of exposure to cold or frost before the next step in germination. Gibberellin is a plant growth hormone (also produced by fungi) that regulates developmental processes and is present in various forms in different plant species. It is known to promote the synthesis of hydrolytic enzymes that are responsible for the weakening and rupturing of the seed coat and the subsequent growth of a seedling from a seed. This is a complex process, and germination can be split into two stages. (Taylor, 2020)

A. Conditions for Seed Germination

Seeds are bespoke to the survival of their species. If conditions are not right, a seed will remain dormant, or may only partially germinate. The requirements for germination are complex and vary between species, but there are a few common themes. Most seeds germinate only in full light, some only in full darkness, and many others under a range of light conditions. Some seeds need alternating temperatures to break dormancy. For example, seeds that germinate in the spring after being dormant throughout the winter are often stimulated by cold temperatures followed by warm. There are also seeds that require a period of exposure to cold or to heat, which is often the forest floor fires, to break dormancy. This is a lot of effort just to get started, but if a seed germinates at the wrong time of year or in the wrong place, the seedling will likely not survive.

Germination begins with imbibition, when the seed takes up water (often the first trigger), swells and becomes turgid. For some seeds, imbibition is enhanced if the seed coat is nicked or broken, or is softened by soaking in water. This permits the uptake of gases, which, like the uptake of oxygen by tissues in a respiring organism, is necessary for cellular respiration. The most common respiratory process involves the uptake of O2 and the release of CO2, energy from the catabolism of organic molecules being used to produce ATP, which is required to drive cellular processes. In fully germinating seeds, the metabolic rate may be three or four times that of dry seeds. High metabolic activity, combined with the reduction in mechanical strength due to both the uptake of water and subsequent weakening of the seed coat, usually results in the radicle breaking through the seed coat. This is done in various ways, some remarkable for the amount of force that a tiny seed and its growing root can exert. For example, seeds of Australian legumes have a small hole at one end and a very hard seed coat. The radicle grows inside the seed and impales it on the hard bit of ground, using it as a lever to push the seed coat apart! (Yan & Chen, 2020)

B. Stages of Seed Germination

After the seed has achieved a state of internal dormancy and is subjected to the appropriate conditions, the seed will imbibe (rapidly take in) water. This causes the seed to swell and the seed coat to rupture. The first outward sign a gardener has that the process of germination has begun is the emergence of a white tendril from the seed called a radicle. This is part of the embryonic root and it grows down into the growing medium searching for a source of water.

The next stage is the emergence of the shoot from the seed. This is the young plant and it still relies upon the seed for its initial source of food. At this point the plant must be placed in a light location to ensure the young shoot is not broken as it emerges from the soil in search of light. Once the shoot has reached light it undergoes photosynthesis which provides the energy to fuel further growth. This phase marks the end of germination and the beginning of the growth of a new plant. A rapid series of developmental stages brings the plant to reproductive maturity when the process of senescence for the species begins, and ultimately ends in the plant's death. (Lim et al.2020) (Enriquez-Hidalgo et al.2020)

C. Factors Affecting Seed Germination

Germination is the process by which a seedling emerges from its seed and begins to grow into a new plant. Vegetative growth is the process of forming shoots and roots from the seedling. Seeds will only germinate under specific conditions. These conditions include: water, oxygen, favorable temperatures, and sometimes light. Seeds will only germinate if the soil's moisture content is high enough for the seed to absorb water. If the soil dries out after the seeds have imbibed water and swelled, germination will stop. Most seeds absorb water to about 25-30% of their weight. Any further increase in soil moisture will not affect germination. When the soil is waterlogged, the lack of free oxygen will also stop germination in the seed. This is because cellular respiration requires oxygen, if the seed cannot respire, it cannot produce energy in the form of ATP and continue germination. The temperature at which a seed will germinate varies a lot between species. Some seeds will only germinate after a spell of cold weather which is known as stratification. Other seeds may be dormant and wait to germinate if the temperature becomes higher. High temperatures also often cause the seed to desiccate and die. Some seeds require light for germination. A good example of this is the seeds of most species of grass. If the seeds are covered by more than a few millimeters of soil, they will fail to germinate. A seed which requires light will not germinate if it is in an area of high competition with other plants because they will shade the seed. (Dantas et al.2020)

3. Growth and Development

When a seed matures, the new life within it seeks to escape. The radicle is the first organ to emerge from the seed. Radicle elongation is soon followed by emergence of the hypocotyl. The root system develops as growth continues, and is used to anchor the plant into the ground and to acquire nutrients. Roots develop primarily from the radicle and the first node of the hypocotyl. At the onset of germination, a young tree seedling has no true leaves, but rather a pair of seed leaves or cotyledons. The shoot develops from the epicotyl, which is the portion of the stem above the point of attachment of the cotyledons. Expansion of the shoot leads to development of primary and future secondary branches. Cotyledons are photosynthetic organs that are temporary and are eventually shed from a plant. A developing plant that does not have any cotyledons is classed as being epigeal; this occurs with many tree species including the oak. If the cotyledons are left below the surface as the shoot emerges, the plant is hypogeal. This happens with some seeds of plants that mainly produce a single subterranean stem bearing simple, scale-like leaves (e.g. the dandelion).

The primary growth of a tree is the elongation of the stems and roots. In this process, the apical meristem, the growth point at the tip of the stem, is the key to whether the stem is woody or herbaceous. The meristem is a small cone of cells located at the tip of a plant which divide in a centripetal manner. If the cells differentiate into conductive tissue and the plant begins to increase in height, it is termed as woody growth. Often there is a sharp transition between the woody and non-woody growth point of a plant. The height of an erect stem is achieved by growth of the stem at the apical meristem, and it takes place in special regions known as internodes. Most deciduous trees have long stems, but some trees such as the many species of Acacia exhibit very little elongation of the stems. Lateral growth in stems is much less common, but can be distinguished by the growth of secondary buds developing into a secondary axis. Eucalyptus trees, however, often have only primary axes with no secondary expansion. Eucalyptus stems also have no petioles, as the leaf blade is directly attached to the stem by a sheath, a method unique to this genus. (Hou et al.2020)

A. Early Growth of a Tree

Trees are composed of organic compounds and water. In photosynthesis, trees convert light energy into chemical energy. This stored chemical energy increases the tree's mass and also releases oxygen into the atmosphere. Leaves are the primary site of carbon assimilation, and they have numerous small openings (stomata) on the underside that allow carbon dioxide (CO2) to diffuse into the leaf. A chain of compounds within the leaves changes the energy from the sun into the chemical energy of carbon compounds. This energy is used to synthesize carbohydrates from CO2. During photosynthesis, water absorbed by the trees' roots is oxidized to release oxygen into the atmosphere and transport carbohydrates from the leaves to all other tree parts. (Abas et al.2020)

Water is a basic necessity for tree growth. It is the medium for all chemical reactions in tree cells and provides the pressure to maintain the morphology of the tree. Stomata are small pores on the leaf surface. They are openings that allow gas exchange between the internal tree environment and the surrounding atmosphere. Stomatal openings are controlled by guard cells to facilitate gas exchange and control the transpiration rate. (Wang-Erlandsson et al.2022)

Tree growth is the change in tree size over time and covers a wide range of processes. Growth may result in an increase in tree size, measured as an increase in volume or mass, and also an increase in tree components, for example roots, stems, branches, and leaves. All trees grow by cell division in their growing tips. Growth in tree size occurs through water uptake and carbon assimilation. (Qi & Zhang, 2020)

B. Factors Influencing Tree Growth

A tree's ability to obtain water and nutrients is more straightforward as these resources can be obtained from the soil by the tree growing new roots into new areas. A tree will be most successful with obtaining water and nutrients from the soil if the water and nutrients are abundant and relatively easy to obtain. In such conditions, a tree may invest more resources into growing new roots as it attempts to exploit the conditions to the detriment of its competitors. An environment that is both very wet or very dry can have negative effects on tree growth as the aeration status of the soil can be too low in the former and too high in the latter. (Vleminckx et al.2021)

Light is a complex environmental variable for a tree to obtain as it is affected by many factors both directly and indirectly. Often the most direct method for a tree to obtain more light is to grow taller. However, this is not always possible or desirable, and a tree may also attempt to obtain more light by increasing the size of its crown. The size and number of leaves on a tree greatly affect its photosynthetic rate and are thus closely linked with growth light. (Liang et al.2020)

A tree is able to grow under a variety of climatic, edaphic, and biotic conditions. Its growth is integrally linked with the resources that it can obtain. The most critical resources for tree growth are light, water, and nutrients. These resources are, for all intents and purposes, obtained by the tree in a static location, and it is the availability of these resources and the tree's ability to obtain them that largely dictate the rate of a tree's growth. (Binda et al., 2021)

C. Formation of Trunk and Branches

This phase typically occurs about one year after germination and long before the first above ground evidence of this growth can be seen. The most familiar characteristic of woody plants is the presence of a hard, cylindrical trunk or stem that raises the plant body above the ground and provides structural support for the leaf and reproductive structures. Trunks are the result of elongated, upright growth at the tip of the primary shoot with the formation of hard, protective outer tissues (bark). All trees have a single, relatively straight, main trunk often referred to as the central leader. Other stems that form off of the main trunk are really branches and, in some plants, where terminal growth is suppressed, it can be difficult to discern between an elongated branch and short, lateral shoot with a small stem and a tuft of leaves. Despite the universal presence of a trunk in tree species, there are considerable differences in the developmental processes that lead to trunk formation in different types of trees.

Some of the most primitive trees (e.g. tree ferns, palms) do not possess true trunks or woody stems. Instead, the leaves (fronds) of tree ferns arise from a central mass of roots and the fronds are annually replaced as the older ones die and collapse. In between there is some straight, upright growth of the rhizome which produces a footprint for the future frond mass. In palms, there is no secondary increase in stem diameter and the base of the leaf mass is only slightly more upright than the initial growth of the plant from the seed. Oil palms and coconut palms are a familiar sight but it's often difficult to determine where the "trunk" begins because the stem simply transitions into the leaf bases. It is often necessary to carve steps into the stem of oil palms to prevent slipping when harvesting the fruit. In both of these cases, lack of a true trunk impairs the structural strength of the plant and imposes limitations on the potential height that the plant can reach. (Rößler et al.2020)

D. Leaf Development and Photosynthesis

Photosynthesis is the process by which green plants and some other organisms use sunlight to synthesize foods with carbon dioxide and water. A chemical process accompanied by the absorption of light and the release of oxygen. In a nutshell, photosynthesis is a process which produces food, fuels the growth of trees, and ultimately life itself on earth. Photosynthesis occurs inside the leaves, in particular, in the chloroplasts. Chloroplasts give leaves their green color. Leaves have evolved to provide the best possible surface for photosynthesis. The majority of broad-leaved trees have a large surface area in relation to their size due to the flatness of the leaf. This provides a large area for the absorption of sunlight. The upper side of a leaf is also covered in a waxy layer which prevents water loss from the leaf and provides protection from attack from pests or disease. This is evident when water quickly forms into droplets on the surface on a rainy day. Very little, if any, water is absorbed. Needle-like leaves of conifers have a smaller surface area which reduces water loss and are often waxy or resinous. Often trees are able to adjust the rate of photosynthesis according to the levels of carbon dioxide in the atmosphere. As the rate of photosynthesis is affected by temperature and water, it is only when conditions are optimum that the light-saturated rate of photosynthesis is reached. An excessive temperature or lack of water will cause the leaf to wilt and the stomata to close, thus stopping photosynthesis.

Leaves are developed at the growing tips of the stems and branches. Young leaves are very soft and delicate and are usually a pale green. The tissues of young leaves have not yet fully developed and are vulnerable to attack from pests or disease. As leaves age, their color may change. When detached from the tree, leaves will go through a series of color changes. This is due to the breakdown of the various pigments found in the leaf; the green chlorophyll breaks down and the yellow or orange carotenes and xanthophylls become evident. These color changes give the leaves of deciduous trees part of their splendor in autumn. When the leaf is severed from the tree, an abscission layer forms at the base of the leaf stalk. This cuts off the supply of water and nutrients to the leaf and seals the join between the leaf and the tree. The leaf is then shed from the tree. Some trees will abort their leaves in a green state, others such as the Sugar Maple, turn a variety of brilliant colors before being shed.

4. Reproduction and Aging

In an attempt to diversify asexual reproduction, some trees have adapted into the flowering plants - angiosperms. The flowers and fruits are the sexual reproductive organs of an angiosperm tree and contain its seeds. At the simplest level, flowers are modified leaves. They generally come in four whorls: the calyx, corolla, androecium, and gynoecium. The calyx is the outermost whorl, made up of individual sepals. It protects the flower when in bud. The corolla is made of petals which are there to attract insects. These are usually brightly coloured and scented. Within the circle of petals lies the androecium, which is the male reproductive part of the flower. It consists of stamens - a filament topped with an anther. The anther produces pollen by meiosis of a microspore, this is known as a microspore mother cell. The innermost circle contains the gynoecium, the female parts of the flower. It typically has a thickened lower end, the ovary, which contains one or more ovules. These are the seeds and by definition, anything containing an ovule is a fruit. On maturing, the ovary turns into the fruit and the ovules into the seeds.

The ovules are actually egg cells, so the pollen produced in a tree's flower must be transported to the ovary of another flower in a process known as pollination. In some species, transportation of the egg for the pool of water may be necessary to facilitate pollination, for example, the ovary may develop into a fruit which drops into a river. In others, such as oaks, the cells divide to produce a long canal through which the pollen travels down. It does this by extending a pollen tube through the style and into the ovary where fertilization takes place. (Wang et al.2020)

A. Flowering and Pollination

Fertilization in the flowers of wind-pollinated trees, such as oaks and pines, begins with the union of a sex cell in the pollen grain with a sex cell in the egg of the female flower. The fertility and health of a tree's seed crop are closely related to the pollen survival, pollen germination, and the growth of the pollen tube within the flower. Among the various tree species, the proportion of pollen grains that actually germinate may range from 1% to over 20%. High temperatures and drought conditions during flowering can be detrimental to pollen germination and may result in a poor seed crop or even seedless fruit. High humidity and rain are also detrimental to wind pollination as they may cause the pollen to become too sticky and thus unable to be dispersed from the anthers by the wind. This can result in the washing off of pollen from the tree and a further decrease in seed crop success. (Win et al., 2020)

Flowering is the process by which trees reproduce. Unlike the more showy and familiar flowers of the ornamental plants in your garden, tree flowers come in all shapes, sizes, and colors. They can be solitary or found in clusters; they may be small, inconspicuous, and without petals. At the other extreme, they can be showy, large, and fragrant. Most trees are monoecious, that is, they have separate male and female flowers on the same tree. A few trees are dioecious, with male and female flowers found only on separate trees. The flowers of a tree are more than just something to look at; they serve a large and important purpose. They are well-adapted tools for wind or insect pollination, the method by which tree flowers are fertilized and seeds are produced. (Cronk & Müller, 2020)

B. Fruiting and Seed Dispersal

Seed production is the last reproductive event in the tree life cycle. Seed dispersion can occur in two ways: sexual and asexual propagation. Seed size varies depending on the species, but the average tree produces a million seeds a year. Using wind as a mode of seed dispersion, a tree needs to produce a high amount of seeds because most seeds will not travel more than a few meters from the parent tree. These seeds are most commonly smaller in size and light so that they can be carried by the wind. Alternatively, a tree may use animals to carry seeds over long distances. To entice animals, a tree may encapsulate seeds within a fruit, which is fuel for animals. Fruits are a modified ovary containing seeds and can be simple, multiple, or aggregate in its construction. Fruits may also be seeded or seedless, with seeded fruits having been formed from a single ovary. An example of fruit dispersion using animals is the sweet chestnut. The spiny green shell is protection for the chestnut seed, and the fruit opens to reveal the chestnut when it has fallen from the tree and is opened by an impact with the ground. Another example can be seen with the ginkgo tree. The foul-smelling seeds are an ovulation from the female ginkgo tree in an attempt to attract dogs or other pets to consume the seed. Ginkgo seeds are not an effective fruit dispersal using animals due to the bad smell and the potential for seed toxicity against animals. An extreme example of effective animal seed dispersal is the coconut. Coconut seeds are able to travel across oceans because the coconut seed falls from the tree and the water carries it to a new location where it may be washed up on a new shore and sprout. Some seeds may lie dormant for several years in what is known as a seed bank. This adaptive restraint allows a tree to save seed resources for years when there may be a low chance of successful germination due to prominent competition from herbs and shrubs. (Tiebel et al.2020)

C. Tree Aging and Decline

This third stage of the growth cycle is, like much of the latter part of a tree's life, a transitional phase. It marks a change from the dynamic of growth to one of eventual decay. Often the same factors that brought about the end of a tree's reproductive years are responsible for decline. Stressful times, disease, insect damage, repeated defoliation, and root damage by construction/grading, or changes in the environment such as poor drainage, are all responsible for bringing trees past their prime, even though decline may not be immediately noticeable.

The first visible signs of aging are when a tree reacts to such detrimental environmental factors by reducing its crown size. This is done to minimize energy output and it marks the beginning of decline in the tree's life. Oftentimes, smaller branches at the top of the tree will die and large dead limbs will develop. Trees will not be able to defend against the same level of insect/disease damage as in their prime and more damage will be caused to the tree, further fueling decline. Step by step, trees will lose their vitality and the end result is death. The length of this process varies; from a few years for a damaged oak, to decades for an old but well-maintained beech.

The knowledge of the process of tree aging and the factors involved are helpful in making educated decisions in managing tree populations and individual trees themselves. The goals in management may be to perpetuate a rare old tree or species, or one may want to guide older trees of a certain species into an early decline, in order to replace. Often it is simply a matter of prolonging the life of a valuable shade tree by reducing the rate of aging and decline. By planning and taking the right steps, much can be done to influence the course of events for trees in their later years. (Pretzsch, 2020)

5. Conclusion

The tree is vitally important to the environment and very useful to us. The cherry tree is one of the most admired trees and its life cycle is amazing. The tree's life cycle, the process of reproduction and growth, has evolved as a strategy for making and dispersing seeds. The tree tries to create seeds to produce offspring, ideally very new cherry trees. It does this by creating cherry blossoms. The leaves surrounding the cherries are very hardy to being eaten or damaged, and are also shiny. This makes it difficult for animals to reach the cherries. About 80% of the seeds are eaten by various animals. Then the seeds are excreted away from the next cherry tree, however far away depends on the animal or bird that eats the seeds. There are some seeds that are within cherries which decay and give off heat sometimes for a few weeks. This heat can actually plant the seeds in the spent cherry which makes picking cherries with a small hole somewhat of an annoyance. Then there is the seeds that were eaten by animals which are released in their excrement. The seeds need to go through stratification and will not all germinate at the same time. It can take years for some seeds to germinate.

In order to fully understand the reproduction of a cherry tree, one must have knowledge of how the cherry tree's flower is made within a single year. This like the rest of the tree's processes is also quite unique. The previous year's cherry blossom actually forms a cherry within the spent flower. This is because the stamen and the pistil of the flower make the cherry which is essentially the fruit of the following seed year. Then the cherry flower is quite complex compared to other types of flowers. It has a calyx with 5 sepals, a corolla of 5 pink or white petals, many stamens, and usually a single pistil. This flower actually forms in spring of the seed year. The seed year being the year that would normally follow the year in which the flower is visible. The next far separates for each flower component. In the case of the sepals and the pistil, they disconnect at the end of spring which far too deep to get into now, and the sepal and petals fall off, sometimes giving it the appearance of snowfall. At some point between the end of spring and the start of summer, the stamens disconnect. This in essence, is the process of creating a flower, although quite a backwards process. (Mateos-Fierro et al. 2022)

References

[1] Davies, S.J., Abiem, I., Salim, K.A., Aguilar, S., Allen, D., Alonso, A., Anderson-Teixeira, K., Andrade, A., Arellano, G., Ashton, P.S. and Baker, P.J., 2021. Forest GEO: Understanding forest diversity and dynamics through a global observatory network. Biological Conservation, 253, p.108907.

[2] Gilhen-Baker, M., Roviello, V., Beresford-Kroeger, D. and Roviello, G.N., 2022. Old growth forests and large old trees as critical organisms connecting ecosystems and human health. A review. Environmental Chemistry Letters, 20(2), pp.1529-1538.

[3] Piovesan, G. & Biondi, F., 2021. On tree longevity. New Phytologist.

[4] Zhang, Y. & Shao, Z., 2021. Assessing of urban vegetation biomass in combination with LiDAR and high-resolution remote sensing images. International Journal of Remote Sensing.

[5] Vacek, Z., Vacek, S., & Cukor, J., 2023. European forests under global climate change: Review of tree growth processes, crises and management strategies. Journal of Environmental Management.

[6] Lu, Z., Yin, D., Chen, P., Wang, H., Yang, Y., Huang, G., Cai, L. and Zhang, L., 2020. Power-generating trees: Direct bioelectricity production from plants with microbial fuel cells. Applied energy, 268, p.115040.

[7] Taylor, A. G., 2020. Seed storage, germination, quality, and enhancements. The physiology of vegetable crops. cabidigitallibrary.org

[8] Yan, A. & Chen, Z., 2020. The control of seed dormancy and germination by temperature, light and nitrate. The Botanical Review.

[9] Lim, C.H., Guan, T.S., Chan Hong, E., Lit Chow, Y., Lynn, C.B. and Subramaniam, S., 2020. Effect of different LED lights spectrum on the'in vitro'germination of gac seed'(Momordica cochinchinensis)'. Australian Journal of Crop Science, 14(11), pp. 1715-1722.

[10] Enriquez-Hidalgo, D., Cruz, T., Teixeira, D.L. and Steinfort, U., 2020. Phenological stages of Mediterranean forage legumes, based on the BBCH scale. Annals of Applied Biology, 176(3), pp. 357-368.

[11] Dantas, B.F., Moura, M.S., Pelacani, C.R., Angelotti, F., Taura, T.A., Oliveira, G.M., Bispo, J.S., Matias, J.R., Silva, F.F., Pritchard, H.W. and Seal, C.E., 2020. Rainfall, not soil temperature, will limit the seed germination of dry forest species with climate change. Oecologia, 192(2), pp. 529-541.

[12] Hou, J., Xu, H., Fan, D., Ran, L., Li, J., Wu, S., Luo, K. and He, X.Q., 2020. MiR319a-targeted PtoTCP20 regulates secondary growth via interactions with PtoWOX4 and PtoWND6 in Populus tomentosa. New Phytologist, 228(4), pp. 1354-1368.

[13] Abas, N., Kalair, E., Kalair, A., ul Hasan, Q. and Khan, N., 2020. Nature inspired artificial photosynthesis technologies for hydrogen production: barriers and challenges. International Journal of Hydrogen Energy, 45(41), pp. 20787-20799.

[14] Wang-Erlandsson, L., Tobian, A., Van der Ent, R.J., Fetzer, I., Te Wierik, S., Porkka, M., Staal, A., Jaramillo, F., Dahlmann, H., Singh, C. and Greve, P., 2022. A planetary boundary for green water. Nature Reviews Earth & Environment, 3(6), pp. 380-392.

[15] Qi, F. & Zhang, F., 2020. Cell cycle regulation in the plant response to stress. Frontiers in plant science.

[16] Vleminckx, J., Fortunel, C., Valverde-Barrantes, O., Timothy Paine, C.E., Engel, J., Petronelli, P., Dourdain, A.K., Guevara, J., Béroujon, S. and Baraloto, C., 2021. Resolving whole-plant economics from leaf, stem and root traits of 1467 Amazonian tree species. Oikos, 130(7), pp. 1193-1208.

[17] Liang, X., Zhang, T., Lu, X., Ellsworth, D.S., BassiriRad, H., You, C., Wang, D., He, P., Deng, Q., Liu, H. and Mo, J., 2020. Global response patterns of plant photosynthesis to nitrogen addition: A meta-analysis. Global Change Biology, 26(6), pp. 3585-3600.

[18] Binda, G., Di Iorio, A., & Monticelli, D., 2021. The what, how, why, and when of dendro chemistry:(paleo) environmental information from the chemical analysis of tree rings. Science of the Total Environment.

[19] Robler, R., Noll, R., Annacker, V. and Niemirowska, S., 2020. Interrelatedness of biota revealed in fossil trees from the Permian fossil forest of Northern Tocantins, Central-North Brazil. Brazilian Paleofloras: From Paleozoic to Holocene, pp. 1-47.

[20] Wang, D., Hao, Z., Long, X., Wang, Z., Zheng, X., Ye, D., Peng, Y., Wu, W., Hu, X., Wang, G. and Zheng, R., 2020. The Transcriptome of Cunninghamia lanceolata male/female cone reveal the association between MIKC MADS-box genes and reproductive organs development. BMC Plant Biology, 20, pp. 1-12.

[21] Win, A., Tanaka, T. S. T., & Matsui, T., 2020. How panicle angle and panicle position in the canopy determine pollination and seed set in rice (Oryza sativa L.). Plant Production Science. tandfonline.com

[22] Cronk, Q. & Müller, N. A., 2020. Default sex and single gene sex determination in dioecious plants. Frontiers in Plant Science.

[23] Tiebel, K., Huth, F., Frischbier, N. and Wagner, S., 2020. Restrictions on natural regeneration of storm-felled spruce sites by silver birch (Betula pendula Roth) through limitations in fructification and seed dispersal. European Journal of Forest Research, 139(5), pp.731-745. springer.com

[24] Pretzsch, H., 2020. The course of tree growth. Theory and reality. Forest Ecology and Management.

[25] Mateos-Fierro, Z., Garratt, M.P., Fountain, M.T., Ashbrook, K. and Westbury, D.B., 2022. Wild bees are less abundant but show better pollination behaviour for sweet cherry than managed pollinators. Journal of Applied Entomology, 146(4), pp. 361-371.