

Tree growth and crown development

Trees prioritise growth in height because this determines their position in the competition for light. Once this growth is guaranteed, their diameter increases. **The growth of the tree takes place through the crown.** The shape of the crown is determined by the shade conditions in which the tree grows (competition). **A tree is balanced when its crown occupies at least one third of its height.**

■ Tree growth

The growth of trees takes place both in **height and diameter**. Each of these growths gives different information about different aspects of the tree.

(a) Height growth

Height growth is very important for the tree because it determines its position in the competition for light and is the quick way for the tree to create new branches and enlarge the size of its crown. For this reason, **a tree, once its breathing needs are satisfied, prioritises height growth.** Being a priority, this growth is independent on the level of shade (or competition) the plant has for a wide range of conditions. **When the level of shade is very high, it finally ends up producing a decrease in height growth** and, in extreme conditions, it leads to the death of the tree. Since the plant invests in height growth first, **it reaches its maximum height at a relatively young age.** This degree of independence of the height growth from the competition means that the height/age relationship is considered a good indicator of the potential of a tree to grow in a given site. In fact, **the maximum height of a species in a site, which depends on the type of soil and its climate** (temperature and water), is what defines the growth potential of that species, which we call site quality.

(b) Diameter growth

Once it has guaranteed height growth, if there is surplus, the tree invests in diameter growth. For this reason, **diameter growth is highly conditioned by the competition conditions the tree experiences:** if competition is high, diameter growth is modest, if competition is low, diameter growth is significant. Thus, diameter is the synthesis of site quality, competition and age, and does not give us any information on age or site quality separately. The diameter of a tree has a much more elongated growth over time than its height.

■ The crown depends on the tree's growing conditions

The shape of the crown is the external characteristic of the tree that will give us the most information about its vitality, capacity for growth, response to release and maturity of the tree. A healthy tree will always develop a suitable crown. The size of the crown **is related to the competition for light conditions in which the tree grows and is determined by the living branches.** When the lower branches die because of the shade, the size of the crown decreases. The branches support the leaves, where photosynthesis takes place. **The tree maintains a living branch if its photosynthesis/respiration balance is positive.** If the branch is not well lit and the balance is negative, the branch dries up and eventually falls. When the branch that dries up is large, it costs more to fall and remains dead on the tree for a while.

The size of the crown is related to the health, vigour and diameter growth of the tree (**Figure 1**). **A large, well-lit crown also has better conditions to produce fruits.** We say that a tree is balanced when its crown occupies more than 1/3 of its height, up to half. **With a crown smaller than 1/3 of the height, the tree's vigour and growth is negatively affected.** If the crown is larger than the middle of the tree, the tree has very thick lower branches and a conical-shaped trunk, which can be an inconvenience for using the wood (**Figure 1**).

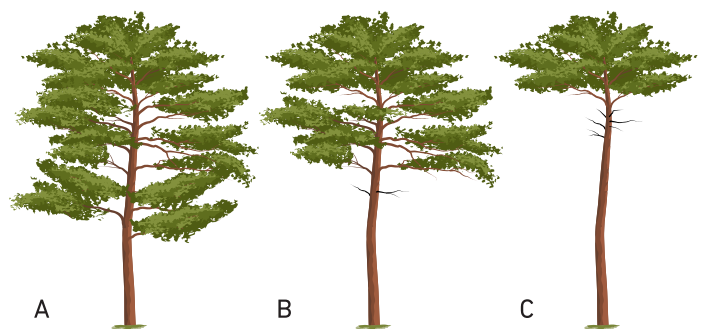


Figure 1. Diagram of the crowns of three trees of the same species growing under different conditions: A) tree that has grown isolated (in the middle of a meadow); B) tree that has grown in a forest with optimal density; C) tree that has grown in a forest with excessive density.

The history of the tree conditions the shape of its crown, i.e. the proportion of living and dead branches. The canopy gives us a lot of information about how the tree has lived, its vitality, what its most likely development will be in the future, and what its response will be if there is a forestry intervention that frees it from the shade. **The goal of the forest manager is to achieve the most appropriate crown size at each moment of the tree's life.** The state of the canopy at the time of making an intervention will condition the tree's response and therefore, the manager's options.

■ Effect of age on crown shape

With age there is a decrease in the crown's recovery speed. Thus, **if a branch breaks because of the wind, in a young tree the growth of new branches will quickly fill the space.** **A mature tree has a slower reaction,** the crown of the tree becomes lighter, with gaps between the branches, globally acquiring an open crown shape, which is the clearest external characteristic to identify a mature tree (**Figure 2**). **These changes with age in the shape and density of the crown have a major effect on the individual's ability to compete,** and the way light and water pass through the crown.

When the tree reaches this stage of maturity, in isolated tree conditions (without competition) it can remain in these conditions for a long time. In fact, **in isolated trees there can be decreases in crown height** (death of part of the crown) that, over time, the tree can recover. However, **when a mature tree faces competition from a young tree,** with a faster response capacity, it usually does **not have the time necessary to recover** and its space is occupied by the young tree which ends up drowning the mature tree. This is a common situation that we find in many abandoned dehesas (**Figure 3**).

■ Tree response to shade release

When a tree is freed from the shade that was affecting it, it must adapt to the new conditions, and this is done by **increasing the size of the crown.** An important factor in deciding whether to intervene in a forest is knowing how to assess **the capacity and speed of the response by the trees to increase the size of their crowns.** The more balanced the crown is before release, the more vigour the tree has, and the faster the reaction. For the same degree of competition, the answer depends on the **shade tolerance** characteristics of each species. **Shade-tolerant species,** such as holm oak, **can keep canopies alive for longer than shade-intolerant species,** such as pines, and therefore maintain the ability to respond to competition release for longer.



Figure 2. Mature tree (flat and hollow crown) and other young ones with a more pointed and closed crown and with the branches upwards. Photo: MJ Broncano.

The rapid increase in the crown is mainly linked to the increase in tree height. The answer is limited to whether the crown is already so small that it affects height growth, or if the individual is of an age that means that it has already reached a height close to maximum and cannot grow any more. **When the tree has already completed its height growth** (which occurs at an early stage of its age), we say that the crown, and therefore, the tree, is already formed, and it is very difficult to modify its growing conditions.



Figure 3. Abandoned dehesa, Vall del Bac (Girona). Photo: Lluís Comas/ Carles Batlles.