# Olive training and pruning.

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## Olive and environment

Olive (Olea europaea L.) is one of the most characteristic tree crops of the Mediterranean basin. During the summer, olive like all other Mediterranean xerophytes is usually subjected to high solar irradiance, high air temperature along with high vapor pressure deficits and limited water availability. Olive is a schlerophyllus evergreen tree with a high degree of drought tolerance, suitable in areas of limited water availability.
The olive ability to acclimate to water scarcity includes alterations in leaf level, associated with biochemical changes, morphological adaptation and physiological changes.

Olive trees can grow also in nutrient poor but well drained soils. The trees need full sunlight during summer and slight winter chill during the winter for flower bud differentiation and fruit set. Olive trees should not be cultivated in areas where the temperature often falls below -5 $^{o}$C, as they do not tolerate very low temperature and get severely damaged by winter or early spring frosts. Olive trees may also be damaged by hot and dry air currents, especially during the period of flowering and fruit set. Heavy rains during that period also deplete pollen from the flowers and result to low fruit set.

## Planting layout

The planting scheme for olive tree is mainly based on the cultivation system that will be applied to the orchard (either intensive or non-intensive). For intensive cultivation fertile soils and sufficient irrigation or rainfall are required, while these are not prerequisite for non-intensive cultivation systems. Olive trees have been planted for years in distances of approximately 10 m x 10 m or even larger. This planting distance leads to a limited number of trees per hectare (approx. 100 trees/ha). In areas which are characterized by a long period of drought such distances offer the trees the possibility to exploit all the available water (photo 1). In areas though where the climate is not so dry and the soil retains the water these distances are by now considered too high.

**Photo 1**. Long distances of olive trees due to low rainfall at the area.

In general two are the main planting layouts:

- The traditional one, where the trees are panted in distances 7 x 7m, 6 x 8m, 8 x 8m or even 10 x 10 m (depending on the area)
- The dense olive planting, where the trees are planted densely at 5 x 6 m or 6 x 6m.

During the last decade a new planting system is being tested in olive culture. It is called high density orchard system and it uses almost 1500-1800 trees per hectare (photo 2). The main objective of this system is to reduce the cost of harvest, which in the traditional olive cultivation participate at around 40-50% to the total cost of olive culture.

**Photo 2.** Super high density olive orchard (young orchard).

## Olive fertilization

Olive trees are demanding potassium, magnesium, nitrogen and boron mineral elements at most.

Nitrogen is most essential for both vegetative and flowering- fruit set production. It may affect in an indirect manner the alternate bearing phenomenon of olive tree. The trees respond readily to nitrogen application when they are grown in low fertility soils and when soil moisture is not a restrictive factor. Depending on soil fertility and moisture, an average application of 500-1500 g of nitrogen per tree is usually recommended for a bearing tree (1kg N= approx. 5kg ammonium sulfate, 3kg ammonium nitrate, 4kg calcium nitrate or 2kg urea). The time of nitrogen application should be related to the availability of water, either rainfall or applied through the irrigation system. Most of the fertilizers containing nitrogen should be spread on the soil and within a few hours rainfall or irrigation should follow, so that there would be minor or zero losses due to evaporation of nitrogen in the form of ammonia. The season of nitrogen application is strongly related to the flower induction and fruit set of olive. Most of the quantity to be applied (2/3) is usually applied during the end of winter, before flower bud differentiation and before new lateral shoot growth. The rest of the quantity is applied during the flowering period (from the pre-flowering stage till the fruit set). At that time one can apply nitrogen either directly to the soil (pre-flowering period) or through foliar application (mainly with urea, pre-flowering and fruit set). By this way the fruit set is significantly increased. Everyone can assess the effectiveness of the fertilization program with nitrogen by checking the length of the new vegetation, which should be sufficient when the appropriate amount of nitrogen has been applied.

Phosphorus deficiencies are not so common in olive culture. Phosphorus is usually applied every two to three years. The application of phosphorus in the soil should be

followed by incorporation; so that the mineral element could gradually reach the root zone (phosphorus is highly immobile in the soil). Phosphorus application is considered necessary in acid soils or soils characterized by high amounts of calcium carbonate.

Potassium is one of the main nutrients in olive culture. High amounts of potassium are removed from the soil with fruit harvest and pruning, particularly in high yield seasons. Regular potassium fertilization is necessary to maximize both yield and quality. Potassium is usually applied during the winter (after incorporation) in order to gradually reach the rooting zone by rainfall. In areas where the availability of water does not pose a problem, potassium application can be done during the end of winter. Olive fruit is highly demanding during growth, which means that an additional amount of potassium should be applied in the years of heavy yield during the period of fruit growing, thus during mid-summer. This application is better to be done using a foliar fertilizer, in order for potassium to be readily absorbed and translocated to the needing parts (sink) of the tree.

Boron is also another major element for olive culture. Boron application as foliar fertilizer usually gives better results when applied during the pre-flowering stages. Thus the trees are sufficiently supplied with boron, which plays a major role to the pollen growth and thus fruit set. Most growers combine during that period a foliar fertilizer of boron along with urea and some times sea-weed extracts in order to achieve the highest fruit yields.

Magnesium is also another major element for olive tree growing. It is major constituent of the chlorophyll molecule. This means that it plays a significant role to the photosynthesis. Magnesium application is usually done only after detection of deficiency. Nevertheless, most of the fertilizers contain a significant amount of magnesium, so that it is applied in sufficient quantities along with the other major elements (nitrogen-phosphorus-potassium, a full strength fertilizer of the type 21-21-21-2 w/w, means that it contains 21% of nitrogen, phosphorus and potassium and 2% w/w of magnesium).

In any case the best way to evaluate the nutrition status of the olive tree and of any plant in general is to proceed to soil analysis along with plant tissue analysis (usually leaves are used). These analyses will give significant data on the status of both soil and plant, regarding the fertilization program to be applied.

## Pruning

Pruning is rightfully considered from many agronomists as the major cultural practice in an orchard. With the pruning the grower adjusts the tree to the specific climatic and soil condition of the area and increases the orchard's productivity. The main aims of pruning are summarized below:

- To give to the tree the best shape under the certain soil-climate conditions
- To balance vegetation with fruit yield
- To minimize the non bearing period
- To prolong the productivity of the orchard
- To delay senescence

There are three main pruning types:

1. pruning during the early stages of tree growing
2. pruning for fruiting
3. rejuvenation pruning

*Pruning during the early stages of tree growing*

The aim of this type of pruning is to develop a tree shape during the first years of the plantation, in order to facilitate all cultural practices (spraying, soil cultivation, irrigation, harvest etc) and to best exploit the tree the sunlight and rainfall occur in the area of cultivation.
The most common shape for the olive tree is the "cup-shaped" tree or "free-cup". To form this shape the newly planted one-year old trees are cut back at a height of approximately 60-80 cm above soil level. The main focus of such a practice is to force 2-4 side branches to be developed, around the tree axis at a distance of 30-40cm from each other and at a height of approximately 40 (the first) till 80 cm from the ground. These branches should comprise in the future the main (primary - limbs) branches of the tree. On these branches new side shoots will be developed by cutting down the old branches at a length of approximately 50cm, thus removing the so called shoot tip dominance and make the lower buds to sprout (photo 3).

**Photo 3**. Shoot tip removal and sprout of the lower buds.

There are also many other tree shapes that are used around the world, some of them are listed below (photo 4).

1. The two-branches shape, which is common to Andalusia, Spain, for table olive varieties.
2. The candlestick shape in Tunisia.
3. The double or triple trunk shape in Seville.
4. The multiconical shape, in which every branch has the shape of a cone, found in some regions in Italy.
5. The spherical cup shape in France, Italy and Greece.
6. The spherical shape, which is not so common because it does not provide ample light to the whole tree.
7. The short cylindrical shape.
8. The non-trunk shape in Tunisia.
9. The free palmate. This shape presents some difficulties and it is not widely used, at least for olive oil producing varieties.

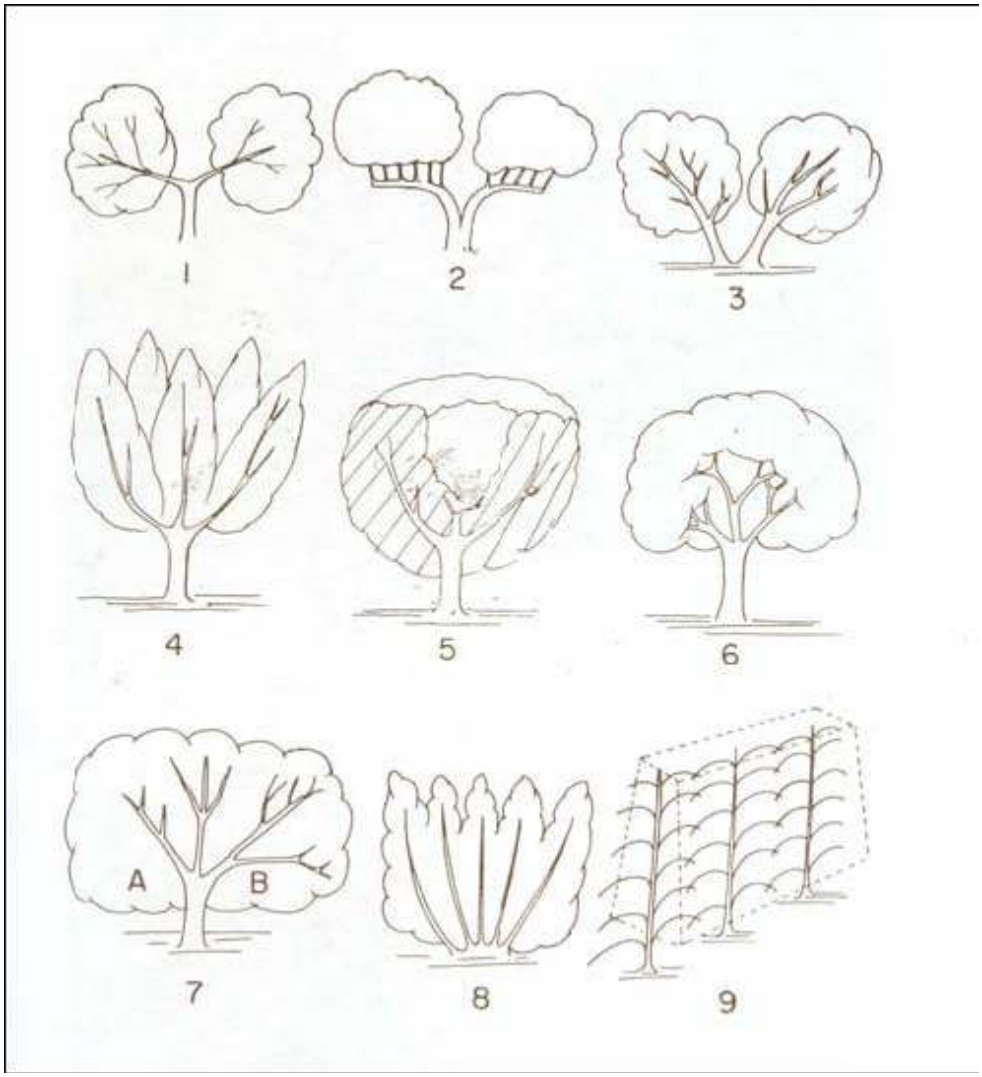


**Photo 4**. Various olive tree shapes.

*Pruning for fruiting*

Olive fruit produce fruits in last year's branches. This means that in order for us to have fruits every year we should ensure adequate vegetative growth every year. Very vigorous shoots are not productive, as they are mostly full of vegetative buds. The aim of pruning thus is to induce branches that will bear fruits by exposing them to light and maintain the fruiting zone vigorous and active.

The olive tree produces fruits mainly at the periphery of the canopy and at it's top. This happens because these parts of the tree are fully exposed to sunlight and become fertile. Based on this fact and the aims analysed above the pruning for fruiting should comprise the removal of any part that shades other younger parts of the trees (photo 5). In this photo we can see that the branch which has fruits on it, will be cut down during the next year in order for the upper branch to bear fruits (due to the favourable lighting conditions) and which eventually would lay over the older branch and shade it, thus making it non fruiting. By this way the branch is not lead away from the central axis of the tree, as can be seen in photo 6.

When a thick branch is to be cut down we must be very careful in order to avoid tearing of the bark of the remaining branch. This is usually done but the practise of totally three cuts as it is clearly shown in Figure 1. The first cut is being made

at the down side of the branch till the middle of it, some centimetres away from the point where we want to cut the branch. The second cut is done centimetres away from the first cut and usually before the completion of this cut, due to the weight of the branch, the branch will fall down, tearing the bark of the remaining branch till the point though of the first cut. Then we can easily cut down the small part remained, to the point of the desired cut.

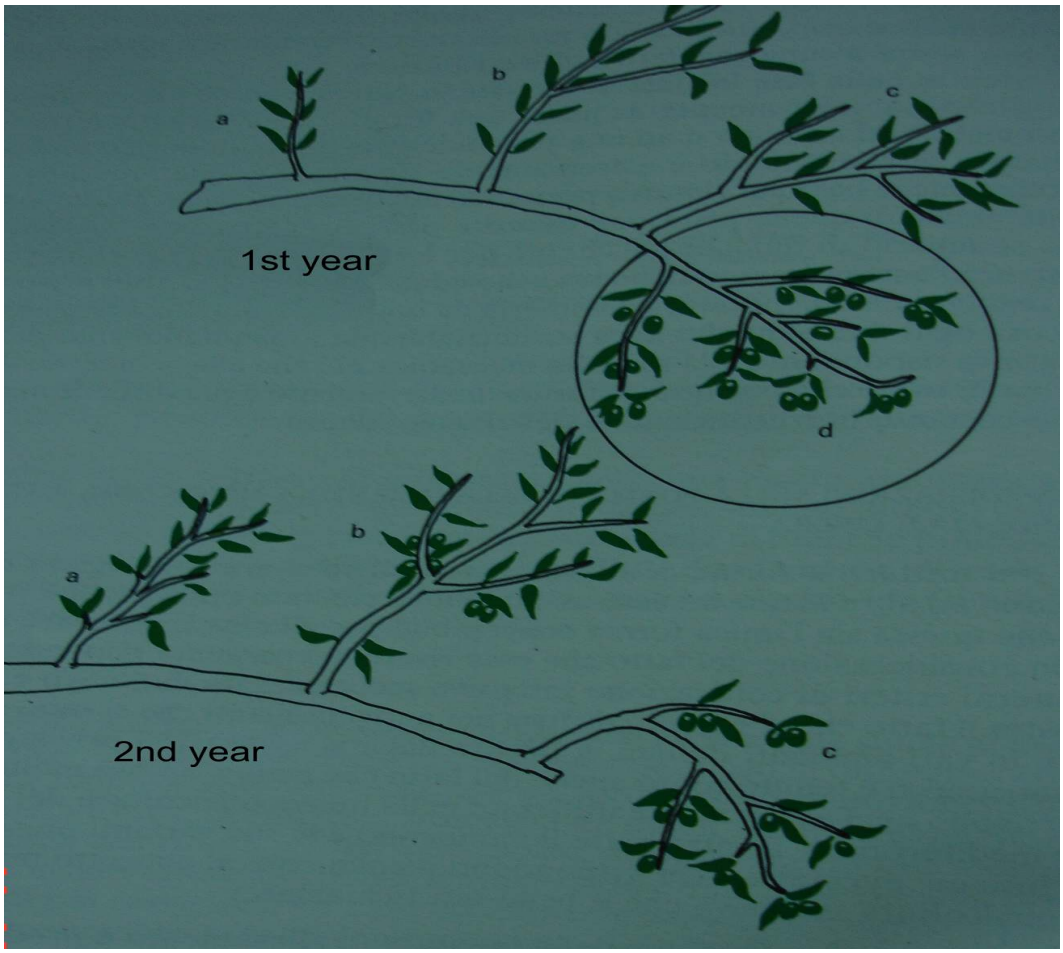


**Photo 5**. Schematic of olive tree fruiting branch pruning during a two year period.

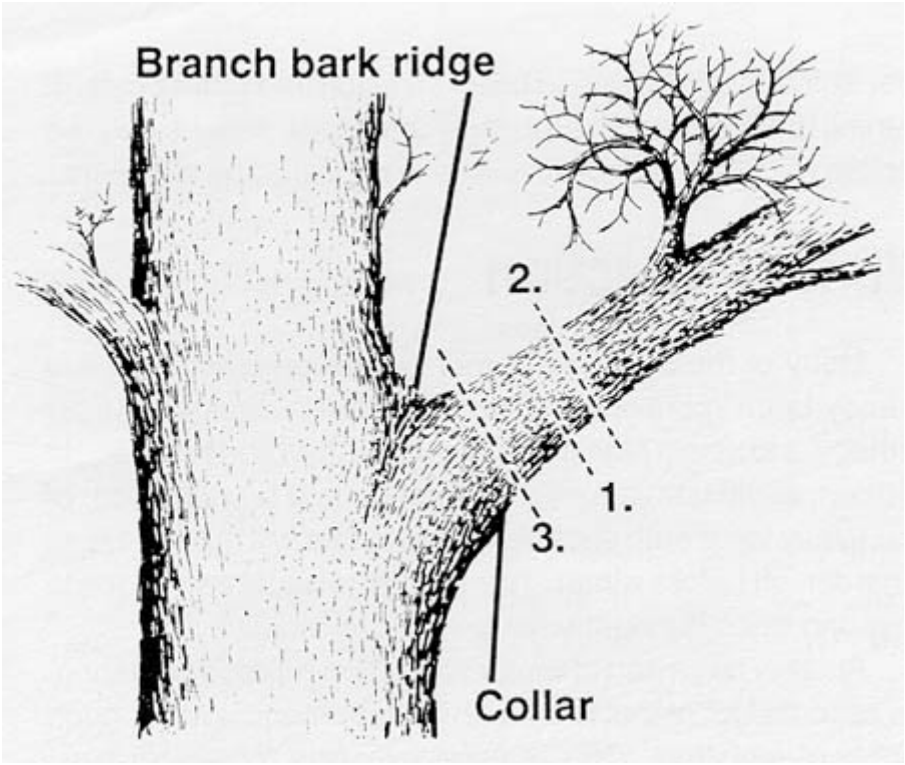


**Figure 1**. the three cut method to prune thick branches or limbs.

*Rejuvenation pruning*

The main characteristic of the olive tree is its longevity, because it has the ability to produce new shoots from nearly every part of the wood, thus making it possible to renovate senescent or frost – fire damaged trees. This type of pruning is comprised by cutting the tree at the main branches or even at its trunk. The most significant practice though is to come back during the next months and remove by hand (when they are still young) the shots that will be of no use to us. We should not wait till the next year in order to give the tree the shape we want (pruning for giving the tree its shape), as it is most likely to have wasted almost one year till the beginning of fruit production. The new tree enters the fruiting period after 3-5 years depending on the cultural practices.

After every pruning or cutting action it is advisable to cover the wounds with wound-sealing pastes and to spray the trees with a copper based fungicide product, in order to prevent the tree form bacterial or fungi infections. Pruning of olive trees can be done during the period between autumn and winter. It is generally performed after harvest but we should wait till the period of heavy rains and frost has passed, in order to prevent infections. We should never perform pruning during a rainy day, as this will probably spread bacteria to the cutting surfaces or inside wounds not seeing by bear eye, resulting in bacterial canker of the live tree (for those varieties susceptible to bacterial canker).

Irrigation and weed control of an olive plantation in a garden is usually a simple practice and there are not any things to be pointed out. Nevertheless, we should know that the critical phases for water stress in olive tree are mainly the period before and after flowering (during the fruit set) when drought can result to significant reduction in flowering and fruit set thus leading to low production.