Training and Pruning the Mango Tree

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Introduction

Pruning, (including training) is one of the most important labors to be realized in a mango plantation to obtain maximum quantitative and qualitative yield. The main objective of pruning in mango is to create a good structure of the tree that permits good light penetration, resistance to wind, less sensitivity to pests and diseases and easy application of aerial treatments and harvest operations. Training should also be directed to obtain a quick entrance in production in the tropics and avoid early flowering in the subtropics.

Most mango cultivars have a rather symmetric canopy. The earlier books devoted to mango cultivation in the tropics recommended the removal of dead branches and those broken by wind or weakened by disease as the only pruning practices. At most, only periodic control of canopy growth, both in height and lateral dimensions, was practiced, with the aid of rotating saws in the more mechanised plantings. It was only in modern mango cultivation that special attention was given to mango pruning in order to create a canopy well adapted to modern intensive mango cultivation.

Although the main reference books for mango [(de Carvalho Genú and de Queiroz Pinto (2002), Galán Saúco (2008), Litz, 2009)] have ‘academical’ chapters or part of them devoted to mango pruning, and many other technical and scientific papers have dealt with this subject, a simple comprehensive recipe that can be used as a practical guide both in the tropics and subtropics for new mango producers, independent of their academic background is needed and we will try to do it in this report.

Training young trees

Since mango flowers mainly in the terminals - i.e. more branches, more yield- the objective of training is to quickly develop a strong framework with many branches well distributed along the stem. Adequate training and pruning maximizes light interception and results in early production, higher yields and better control of pests. While most current training aims to develop a mature tree with a spreading inverted umbrella or in a vase shape, a cubic structure is pursued for hedgerow conduction or to facilitate mechanical pruning.

It is generally recommended to keep trees in the nursery until they reach a height of 0.80 m (1 m for long pendulous growing cultivars like 'Keitt') before field planting. All lateral shoots produced below 0.80 – 1 m height should be eliminated in the nursery soon after their apparition. Training should begin soon, about 6-8 weeks after planting in the tropics, but this should be done only under favourable conditions for growth, avoiding dry periods in non-irrigated plantings, excessive hot temperatures and winter cooler temperatures, especially in the subtropics, to avoid undesired early flowering and promotion of vegetative growth.

The following steps should be followed for training young trees.

1) Cut the young tree to a single trunk at above 80 cm above ground (at least 1 m for the cultivar Keitt or similar cultivars with long spreading shoot habit). Many cultivars exhibit a strong tendency to produce shoots from the same point on the stem, particularly if the cuts were made just above a terminal node, giving to week trees susceptible to be broken by wind. To avoid this problem, cut the stem just below a node to favour the development of several side shoots from the leaf axils, which will thus, arise from different heights of the main stem (fig.1-5).

After the initial cut, select 3-4 (preferably 3) healthy and strong lateral shoots emerging from different heights and with an angle of insertion to the main stem between 30 - 45º that will become the main branches of the tree. Once two mature flushes have been produced - approximately when they reach 40-60 cm in the tropics - cut them again below a node, selecting again 3-4 emerging shoots coming from each cut and continue doing the same process until the desired tree structure is achieved or until flowering. In the case of cultivars with long pendulous habit, like 'Keitt' it may be better to do the successive cuttings after the production of only one mature flush.

In all cases clean eventual sucker growth from the rootstock, by removing all growth produced below the grafting union. Control of flowering is a major issue during early canopy training, particularly in the subtropics, and all flowers must be removed during this period (see paragraph **Pruning for control of flowering**).

By the end of the 3rd year after planting or better after the third cut, trees may be allowed to flower. The last cut is better done in early autumn to take advantage of the low winter temperatures inducing flowering.

A somehow different approach to training has been recently proposed in Florida with a system that offer the possibility of training by combining bending with pruning following the procedure by Ledesma et al., (2016) which can be described as follows:

The grafted plant is tipped at 50 cm to induce precocious branching maintaining 2 shoots which are tipped after the second vegetative flush. Then each branch is bended pulling it down to the horizontal (fig. 6). This system has proven to be useful for the cultivar Mallika grafted on 'Turpentine' which develops a strong branch structure and initiates flowering only 10 months after planting.

More years may be necessary, even for the cultivar Mallika, to properly evaluate this bending procedure which can produce and maintain small, mushroom-shaped trees capable of early production of large crops and high-quality fruit in the tropics. The procedure should also be validated for different cultivars, with different variants like the height of the first tipping in different locations and the long-term effect of it in the full production phase, but looks promising for mango cultivation.

Mangos can also be trained to grow on trellises with several strings at different heights. The plant should be allowed to grow to the height of the first string, and then the stem should be cut to obtain three shoots. Two of them will be conducted laterally along the string and the other will be allowed to grow erect until it reaches the 2nd string, when the process is repeated for the 3rd string. Trellis systems are common in greenhouse cultivation in Málaga, Spain at planting distances of 2.5 x 2.0 m with 3 horizontal wires, at around 1.00, 1.80 and the highest at 2.50 m above the soil level. Cultivars like Keitt with long shoots are better adapted to this system than other cultivars (fig.7).

Pruning adult trees

The objective of pruning an adult mango tree is to obtain and maintain a productive tree, full of terminal bearing shoots able to produce well coloured fruits of the size demanded by the market. Pruning can be done by hand or by machinery, using rotatory saws (However, additional hand pruning is still needed, particularly in the interior of the tree).

During the early productive years until the trees attain the full allotted lateral size - touching the next tree within the line or occupying the maximum space allowed between rows to facilitate full machinery movement between rows, or manual operations - pruning will be limited to:

Eliminate any diseased inflorescences and also those without fruits or with aborted fruits.

1) Cut immediately after harvest all flowering or not flowering terminal just below the last node to allow quick production of new shoots that become the new fruiting terminals for the next season.
2) Removal of disease and dead branches.
3) Remove all low growing branches interfering with watering or machinery movement and any internal branches which impedes light penetration.
4) Open the inside of the canopy (once each 2-3 years) by eliminating those branches with an angle of insertion lower than 45º and all shoots growing toward the inside of the canopy to allow air movement and better light penetration, with the additional advantage of obtaining in many cases cauliflory flowering in old wood (fig.8). This operation, as well as the removal of low branches, should preferably be done at the end of the winter, to avoid burning of the exposed internal branches due to excessive hot weather or excessive insolation. However, opening the canopy is not recommended in the subtropics because, due to the slower rate of vegetative development after pruning, the exposed parts of the tree are not so quickly covered by the foliage and burning of branches can also occur due to exposure to the high summer temperatures. Those branches much exposed to the sun should be painted with white paint (vinyl or lime slurry) to avoid sunburn. A fungicide paste should be applied at the pruning cuts specially in the more severe cuts in humid and hot areas.

Pruning operation once trees has attained full size only differs from the precedent years in that:

5) All terminals should be pruned back (always behind a node) in order to maintain the trees at a diameter that permits the use of machinery and allows trees to just touch within the rows. This usually correspond to the removal of the 2-3 flushes (approximately 0.50-0.75 m back with a width lower than 2.50 cm) produced during the last growing season in the tropics. It is more recommended to do annual pruning in order to avoid the need of severe pruning which can delay or even inhibit the next year flowering. Terminals should be pruned uniformly around the whole canopy to obtain a synchronised vegetative growth which will give rise to a synchronous flowering. This operation should be done after harvest in early autumn in order to get mature flushes at the moment of the low winter inducing temperatures conducting to flowering.

6) Eliminate all vertical shoots.
7) Keep the tree at an appropriate height (usually 3,5-4.5 m).
8) If mechanical pruning is used, it is also recommended cutting only branches with a diameter lower than 2,5 cm (1 inch) all around the canopy keeping the saws with an angle of 25-30º and trying to get always a more or less pyramidal shape to obtain maximum light interception.

Of capital importance for pruning is to stimulate uniform production of vegetative shoots for the following season. This is done to avoid competition for water and nutrients between young fruits and young shoots when temperatures are warmer. In the case of late cultivars like 'Keitt' terminals should not be pruned immediately after harvest under subtropical conditions. Otherwise, the subsequent vegetative growth will not have time to mature and flower in the next season and alternate or biennial bearing will occur. In these cultivars, selective pruning of all non-fruiting inflorescences or those with disease problems, e.g., anthracnose, powdery mildew and black bacterial spot, at the end of the spring is recommended. A minimum of 25% of terminals should be pruned at this time. This selective pruning of part of the tree also preserves foliar surface area during the winter and increases available carbohydrates at fruit set. The other alternative for the subtropics done in Málaga, Spain, is the production of a crop each two years by doing the following procedure (Galán Saúco, 2019) (fig. 9):

Year ON (High yield). - Total or partial machete pruning of terminals to induce a 2nd flowering with good moderate size fruits.

Year OFF (without fruits). Spring pruning of productive shoots of the previous year for production of vegetative shoots for next year 'ON'

This practice allows a good crop every two years and have the additional benefit of obtaining smaller size and more coloured fruits which is a market advantage particularly for the cultivar Keitt that otherwise produce green to yellow fruits with sizes too big for the European market.

Even with an adequate pruning some trees, and particularly cultivars with long spreading habit like 'Keitt', especially young trees when heavy loaded with fruits, will require additional support for low branches to avoid fruits touching the soil. The most common system of propping includes the use of a simple supporting stake of around 1 m size either provide with a hook and foam cushion or with a hole to which you can tie the branch. A different system is common in China where only one pole of around 2 m height is placed in the middle of the tree from which raffia tapes goes to each low branch requiring support (fig. 10).

Pruning for control of flowering

Control of flowering trough pruning is a major issue during canopy training in the subtropics, and all eventual flowers produced during this period (2-3 years depending on cultivars) must be removed to avoid stunting of the trees. Although this problem can be managed with growth regulators like giberellins, the best is through manual removal of any appearing inflorescence by cutting them at least 5 cm below the terminal node when the fruits reach pea size (Galán Saúco, 2008) (fig.11). This normally coincides with spring time when temperatures are not conductive to flowering. Shoots produced on the cut terminals generally develop vigorous vegetative growth instead of new inflorescences. The inflorescences should not be cut at an earlier stage to avoid production of new inflorescences instead of vegetative shoots.

Delaying annual flowering in adult trees to avoid flowering during low winter temperatures (below 15ºC) is also very important for commercial cultivation of most mango cultivars in the subtropics to avoid embryo abortion problems. Flowering can be delayed by manual or chemical means (Galán Saúco, 2008), but only pruning procedure, as follows, is described here:

1) Cut all inflorescences immediately above the terminal node at full flower stage (fig.12), by the end of winter - beginning of spring to ensure that low temperatures can still occur for flower induction and emission of a second flowering.
2) Eliminate also all young vegetative shoots present at the time of removal of the inflorescences to eliminate competition for nutrients and to diminish the putative flower inhibitor produced in the leaves.
3) If the removal of the first flowering is done in time, a second wave of flowering will occur in most terminals coinciding with the onset of warmer spring temperatures. These inflorescences emerge from the basal and axillary buds and, generally, set normal fruits rather than aborted ones (also called ‘mangos niños’ in Mexico). If the first flowering occurs very early in the season, it may be necessary to wait until the fruits coming from this flowering reach pea size to ensure that new inflorescences develop under warmer conditions. Some cultivars, like ‘Lippens’, that are not so sensitive to embryo abortion may not require the delaying of flowering, but flower removal can be useful for the synchronization of flowering or for delaying the harvesting period if market demand justifies.

Fruit and Shoot Thinning

Thinning of fruits in order to obtain fruits of adequate size for the market can be useful in years of heavy load for some cultivars that produces several fruits at the same inflorescence. The recommended procedure may consist in eliminating regularly around the whole canopy until around 25% of the inflorescences and keep not more of 2.3 of the biggest fruits in the remaining inflorescences. These figures are, however, depending on the cultivar and must be studied for each particular location. Thinning should be done when it is possible to distinguish those normal fruits from those aborted (fig.13).

If foliage is too dense it may be adequate to eliminate part of it in the proximity of fruits to improve their colour, but caring not to expose them much to avoid sunburn.

Pruning procedure for tree rejuvenation

This can be done to revert trees to a manageable size and shape, with the objective of creating well equilibrated canopy structure with plenty of terminals able to get heavy annual crops. The main objective of this pruning is to recover the productivity of an orchard once this has been lost because of aging and/or inadequate pruning. Trees of moderate size (3-6 m) may only require adjusting tree shape through a reduction of height and width to allow light penetration to the lower part of the canopy and start again pruning operations as it is recommended for adult trees, but old mango plants will require a more severe pruning.

The most usual procedure for this pruning that is usually done after an off year is as follows:

1) Cut the tree with a chain saw at a height of 1m. If the tree was well formed normally this cut allows keeping the three main branches (fig. 14). The cut should be done slightly obliquely to avoid water accumulation in the cut during the rainy season. The best moment for this operation is at the beginning of spring to ensure quick regrowth of the trees after pruning.
2) Seal all the cuts with vinyl or similar painting and add cupper hydroxide or an appropriate fungicide to the painting to avoid rooting.
3) Allow emerging shoots to mature and select and conduct the training as explained in the training section either by selecting three vigorous shoots from the single trunk or from each of the main branches if existing.
4) Do not allow the growing of many branches in the center of the tree to allow light penetration.

This operation should not be done during the dry season in non-irrigated orchards to avoid the risk of losing the trees.

Pruning procedure for varietal change

The procedure for varietal change does not basically differs from that indicated for rejuvenating old trees, except that, in this case the cuts should be done below the grafting point (fig.15-16), unless interested in having an interstock. After the pruning, one should either do top working of the main trunk or grafting with the new cultivar the selected emerging shoots produced after pruning. A different approach is done in China where no pruning is done but grafting all the terminals with the new cultivar (Fig.17). Although this may be quicker, it is generally too expensive, especially in big trees, due to the cost of hand labour.

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Figures:

Fig.1 Initial Pruning cut during training.

Fig.2.Young tree formed by 5-6 initial shoots coming from the same point of the stem. Week tree susceptible to breaking by excessive fruit load.

Fig.3. Young tree formed by 4 initial shoots coming from different points and angle with the stem, Good canopy structure for heavy fruit load.

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