

GUIDANCE I

Pruning

Version 1



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ALLIANCE**



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OBJECTIVE

This guidance serves as the guidance document accompanying the standard requirements 4.2.1 and 4.2.2 on pruning.

Definition: *the term “Pruning” refers to the selective seasonal or annual activity to remove dead, diseased or non-productive branches, to manage pests and diseases and/or to give shape and redirect growth (formation) with the aim of influencing harvest, productivity and quality, and to ease harvesting itself. Pruning can also be done for crop reproduction/renovation (cuttings, grafting) and for rejuvenation/revitalization of the crop.*

SCOPE

This manual focuses on the theme of “pruning” in the section 4.2 Pruning and Renovation of Tree Crops, in particular on the crops coffee, tea and cocoa. It covers the following topics: purposes of pruning, timing and frequency of pruning, pruning techniques and tools, and required aftercare.

Although this guide will focus on pruning of plantation trees, pruning can also refer to the management of shade trees in a plantation in order to achieve ideal microclimate conditions in the plantation (light, shade, aeration, rain through-fall, humidity, temperature buffering, etc.). Pruning of shade trees is necessary to balance the trade-off between shade cover and yields, as increased light intensity generally induces larger numbers of flowers.

AUDIENCE

This manual serves as a guide for auditors, for Internal Management System (IMS) administrators preparing for the audit, as well as trainers and group leaders, to assist them in interpreting the criteria in the standard for correctly applying adequate pruning methods to increase productivity and quality of the produce.



1. INTRODUCTION

In this guidance, the standard requirements are presented along with any indicators (if available) and explained in detail. The underlined terms in the requirement are binding, and the ones related to pruning are presented in the definitions at the end of this document. It is important to consult the glossary when implementing the standard requirements.

What is pruning?

Pruning is an important cultural practice for maintaining tree crops and as such is an integral part of any tree plantation management. Together with the right climatic conditions, use of the right cultivar, integrated pest and soil nutrient management, pruning can help to obtain better yields and to maintain a healthy plantation that remains productive for generations. It describes the targeted removal of unwanted or less productive plant parts, and as such pruning always reduces the foliage of a tree and, therefore its ability to photosynthesize and produce energy. Principally, a yield reduction in the immediate period after pruning is to be expected while the tree is recovering and putting out new foliage. Pruning should, therefore, always be a deliberate and planned effort. It should be clear what the purpose, desired outcome, and timing of the exercise are in order to avoid damage and to maximize its benefits. Climate change leads to erratic weather patterns. Pruning cycles need to take into account that during the period of recovering from pruning, a crop will be more affected by drought. Mulching is an important practice to avoid larger damage from stress during dry periods after pruning.

At the same time, after pruning, the root system of a tree remains intact and serves a smaller number of branches and leaves above ground, thereby increasing the water and nutrients available to each bud and shoot. This usually stimulates a flush in new growth, usually near the cut, and therefore pruning needs to be timed. If flush growth is not desired (e.g. in fruit and nut trees), the pruning has to be done during a period when the tree is dormant (end of the dry season or winter) without reducing or delaying flower and fruit development. In this case, the aim of pruning is to achieve bigger and higher quality fruits instead of leaf mass. Where appropriate, pruning residuals should remain in the plantation to serve as mulch cover between the rows to improve soil health.

Pruning serves different purposes and, depending on the tree's own architecture, different parts of the tree might be pruned, or the pruning technique might differ. We distinguish between three major types of pruning:

1. Formation pruning

Formation pruning serves to train a young tree and to manage the shape and size (height for easier access) of trees. Formation pruning is done to stimulate new growth of productive parts or desired branches as well as to eliminate unwanted branches to produce a strong and well-balanced frame. Formation pruning is also done to ensure sufficient ventilation and light exposure for fruits and to ensure that the trees are kept at a comfortable size for harvesting.

2. Maintenance/sanitary pruning

Over the lifetime of a tree, regular pruning is needed to maintain its health and shape. Maintenance pruning assists in maintaining an ideal ratio between vegetative growth and fruit production, with the goal of increased or better-quality yields. These pruning practices also aim at microclimate management (sunlight, air, etc.) for the purpose of pest and disease control or even serve sanitary purposes by eliminating dead or diseased plant parts.



3. Rejuvenation pruning

Pruning for rejuvenation purposes is done to bring forth new vigor in old trees. It usually involves the removal of larger parts of the tree or even the entire tree. It becomes necessary when a tree needs complete rehabilitation because its productivity has substantially diminished or when the tree has suffered from severe pest or diseases damage in the upper part.

Depending on the tree crop, a **pruning cycle** usually refers to either the cycle of formation, maintenance, and rejuvenation pruning or the time between two major pruning activities (e.g. a light prune (LP) in tea).

Shade tree pruning:

The canopy in shaded tree crops includes other tree species. Shade management plays an important role in productivity and Integrated Pest Management (IPM). The density of the canopy determines the microclimate, ventilation, light penetration, and throughfall of rain (important for cocoa pod-diseases like Phytophthora). It needs to be managed through regular pruning of branches of shade trees. Pruning frequency depends on regrowth rate and crop life-cycle stage. Pruning residuals should remain in the plantation as mulch.

Aftercare:

To avoid damage or mortality from pruning, it is important to time these activities in such a way that the trees will be least affected by the loss of foliage. This is usually the case at the end of the rainy season. The onset of rains will also assist in quick regrowth and prevent drought damage. Shade management and mulching also play an important role in the aftercare of pruned trees. Fertilizer and/or animal manure is usually applied before and/or after pruning to assist in hastening recovery as well. Larger cuts might need to be covered with tar or wax to seal the wounds quickly and to avoid entry of pathogens.



2. PRUNING REQUIREMENTS IN THE STANDARD

OVERVIEW

In this section, there is one core requirement and one smart meter requirement¹ as below:

No.	Core Requirements	Applicable to			
		Group Certificate			Indiv. Cert
		Small farms	Large Farms	Group Mgt.	S/L
4.2.1	<p>Management implements a <u>pruning</u> cycle for adequate formation, maintenance and <u>rejuvenation pruning</u> according to crop needs, agro-ecological conditions and applicable pruning guidelines.</p> <p>Group management supports group members to implement this pruning cycle.</p> <p> Please see Guidance Document I: Pruning</p>		✓	✓	✓
No.	Mandatory Smart Meter				
4.2.2	<p>Producers carry out <u>pruning</u> according to the requirement in 4.2.1</p> <p>Indicator:</p> <ul style="list-style-type: none"> % of <u>group members</u> that adequately prune according to crop needs, agro-ecological conditions and applicable pruning guidelines 	✓			

IMPLEMENTATION OF THE REQUIREMENTS

Core requirement 4.2.1

Management implements a pruning cycle for the adequate formation, maintenance and rejuvenation pruning according to crop needs, agro-ecological conditions and applicable pruning guidelines.

Group management supports group members to implement this pruning cycle.

Objective

Establishment of a pruning cycle that ensures crops are maintained at a healthy state to ensure longevity and increased profitability.

Applicability

This core requirement is only applicable to group management and large farms within group certification and to individual Certificate Holders. Group management is responsible for supporting its members in the implementation of the pruning cycle.

¹ **Core requirement:** these are requirements that always have to be met in order to achieve certification. Most core requirements prescribe good practices with respect to key sustainability risk topics and are formulated as compliance requirements (a binary pass/fail).

Smart meter requirement: Smart meters aim to give farmers a structured way to incorporate continuous improvement on context-specific data. Smart meters do not have predefined targets set by the Rainforest Alliance. Instead, the producers themselves set the targets for these indicators and define the adequate actions to take to realize these improvements. Producers conduct a baseline assessment and define targets for these indicators in year 0 or year 1 (depending on the requirement), plan and implement actions to achieve the targets, and then monitor progress towards the targets. Producers use the indicator data to reflect yearly on the progress, and to adapt the activities in case little or no progress is shown. This provides producers with a feedback loop so that they can continuously improve their practices



General guidance

What are pruning cycles?

A pruning cycle usually consists of a formation pruning phase, a maintenance phase, and eventually the rejuvenation phase. The length and frequency of the pruning activities in each cycle and phase depend on the tree crop and variety. Example cycles will be given below in the crop-specific guidance.

How do trees grow?

Trees and shrubs put on new growth each year from the ends of the branches (terminal buds) and from side branches (lateral buds). Terminal buds determine the direction of growth on the main branch. Lateral buds determine the growth and direction of side branches and twigs. Dormant buds, which are less visible, only begin to grow if the plant suffers an injury to its terminal and lateral buds. Pruning makes use of lateral and dormant buds to redirect growth or rejuvenate a plant.

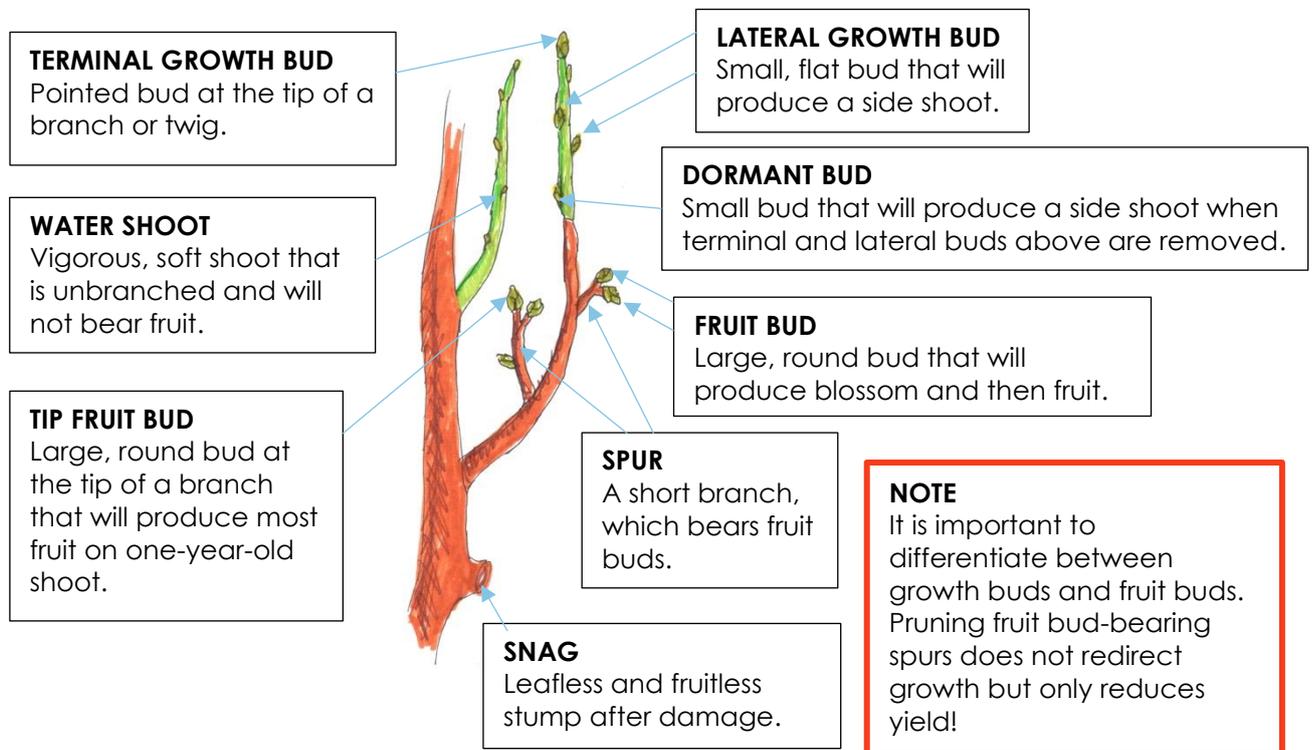


Figure 1. Forms of new growth on a tree



Key elements of formation and maintenance pruning:

1. Elimination of non-desired plant parts like water shoots, suckers, competing leads, etc.
2. Improvement of light exposure and ventilation by removing inward, crossing and crowded branches, etc.
3. Sanitation of trees by elimination of damaged, dead, diseased or infested parts.
4. Management of size and shape of trees, e.g. through topping, to facilitate better access, easier harvest, or pest and disease control.

Stimulation of productive parts and desired branching, e.g. to achieve an increased leaf surface.

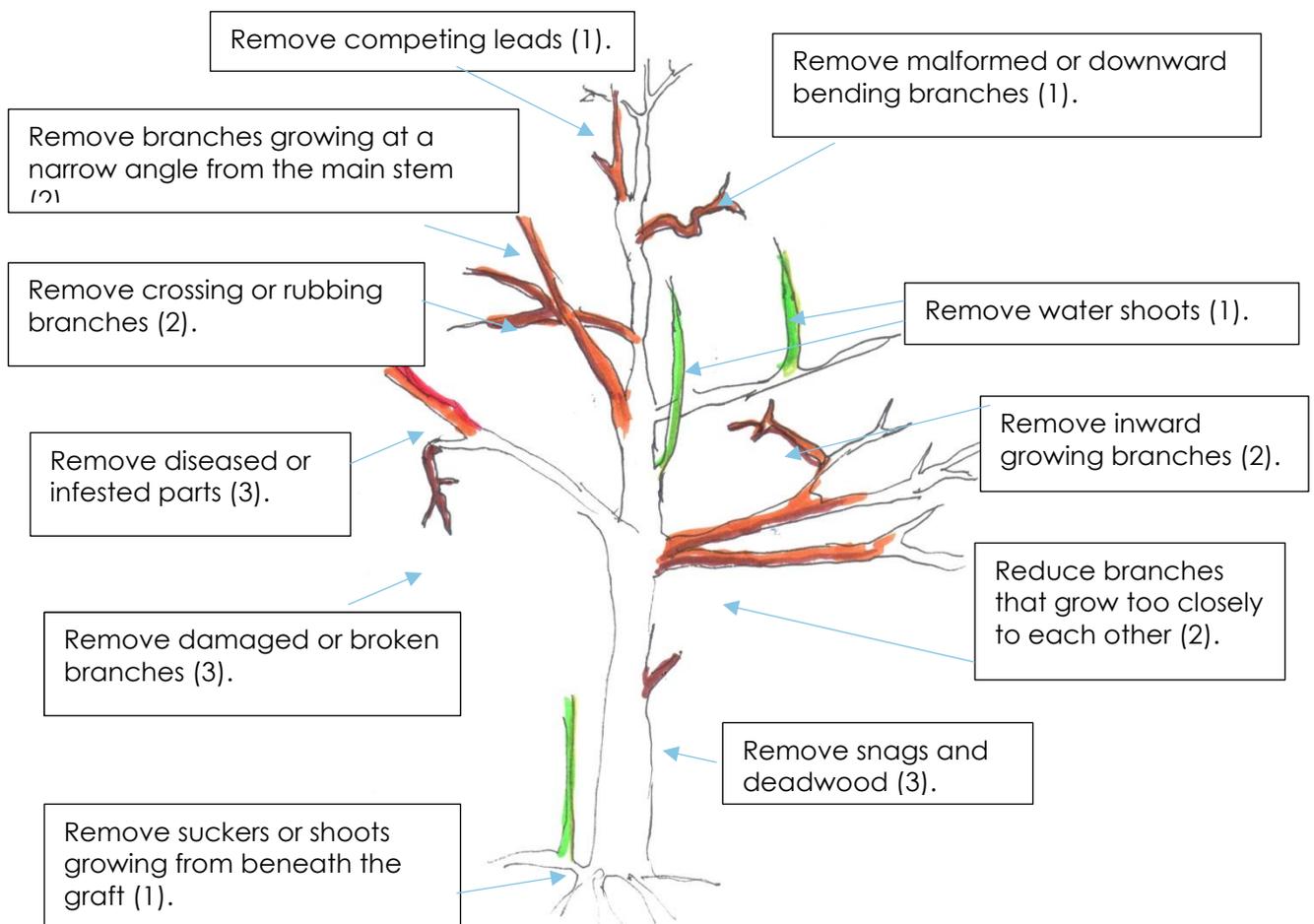


Figure 2. Thinning



There are two types of pruning cuts – *thinning* and *heading*:

Thinning describes the removal of a branch or shoot as in Figure 2. Thinning cuts are made to reduce tree size and to remove excess shoots, as they do not induce vegetative growth near the pruning cut. Thinning cuts are also used to remove shoots that bore fruits the previous season to induce the development of dormant fruit buds for the next season.

Heading cuts describe the removal of the terminal buds to encourage shoot development from the two or three lateral buds below the cut. It also encourages shoot development from dormant buds embedded in the bark within several inches below the cut. Heading cuts are therefore used to stimulate lateral growth and to induce branching. The lead branch can be headed to encourage the development of a wider crown.

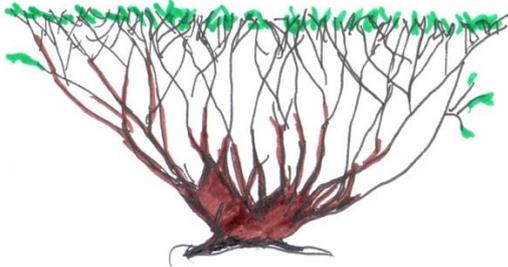


Figure 3. Branching induced by heading cuts at several growth stages

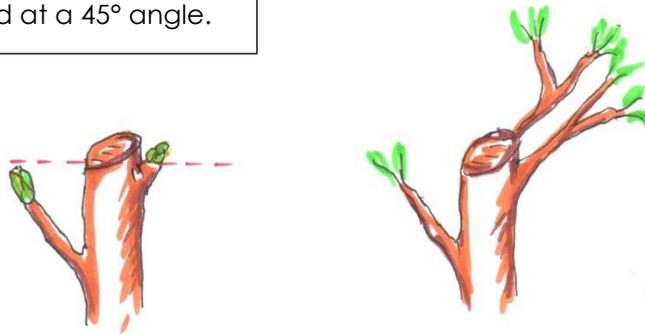


New shoot growth is most vigorous when heading cuts are made into one-year-old wood. Regrowth is also related to the orientation of the branch, to the severity of cut, and time of season when pruning is done. Strong shoots have well-developed buds along with the upper three-fourths of the shoot. The strongest regrowth occurs when shoots are headed to not more than 3/4 of their length. Thinning cuts, on the other hand, are made very close to the point from where the shoot originated from the older branch. Such cuts that leave very short ends usually result in less regrowth. The more upright the shoot, the greater and more vigorous the regrowth. Pruning cuts made in the dormant season stimulate the most regrowth as the tree is preparing for the next flush of leaves, while those made late in the productive season, when the tree is preparing for dormancy, stimulate less regrowth. Heading cuts are, therefore, usually made during dormancy, while thinning cuts are made just before dormancy.

HEADING CUT

The lowest point of the cut is at the same height as the top of the lateral growth bud and slants upward at a 45° angle.

Figure 4. Vigorous regrowth after a heading cut



THINNING CUT (a)

Cut is made directly above a healthy side branch and slants downward at a 45° angle.

Figure 5. Minimal regrowth after a thinning cut

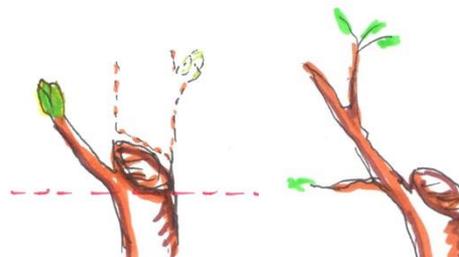
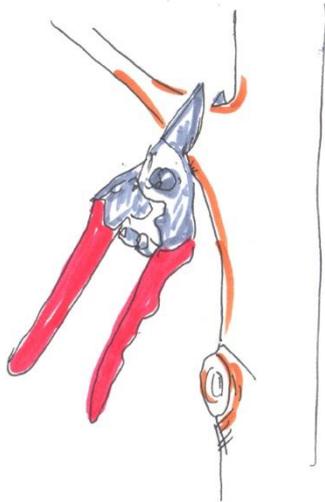


Figure 6.

THINNING CUT (b)

Alternatively the side branch is completely cut back to the main branch.

Thinning cuts are also used in de-suckering. Care needs to be taken to completely remove the sucker directly on the stem-base to discourage new growth from the pruning cut.



The cut needs to be done in such a way that they leave minimal damage to the tree. Care should be taken that larger branches don't break under their own weight during pruning. The wound should be kept minimal to avoid infection. The cut should be made directly on the main branch, side branch or growth bud, as leftover parts will die back. Horizontal cuts should be avoided as water could collect on the cut and cause rot. Cuts at a slant over more than a 45° angle, on the other hand, are larger than necessary and can cause the tissue (and buds) beneath to dry off.

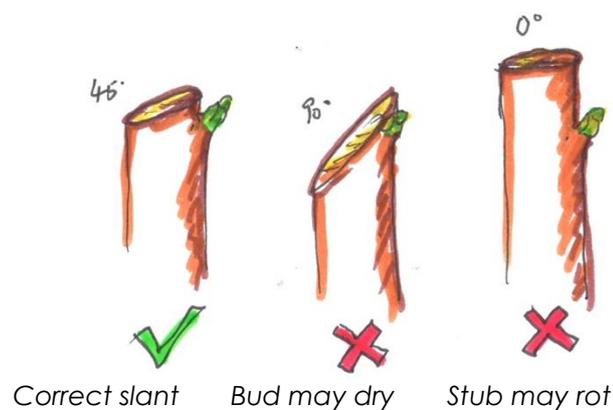


Figure 7. Correct angle of a pruning cut

Key elements of rejuvenation pruning:

Heading into older wood is not as invigorating as cuts made in one-year-old wood. Nevertheless, it still increases total shoot growth. Once a tree or shrub reaches its peak in productivity or growth vigor it might require more extensive rejuvenating pruning. To restore old, straggly but otherwise healthy trees the oldest branches are removed to induce new growth and renewed productivity. This can be done extensively (stumping) or gradually (staggered rejuvenation). The tree responds with regrow from its roots, becoming once again a compact and youthful plant, with maximum bloom. Rejuvenating pruning is usually repeated every 5–7 years before too many of the branches have become woody or died back. If more than 1/3 of the branches are already without healthy foliage, the tree will probably not respond well to rejuvenating pruning.



Gradual rejuvenation pruning:

Gradual rejuvenation is done over a period of three years to allow regrowth of young shoots in the process. Each year only 1/3 of the oldest, unproductive branches are removed.

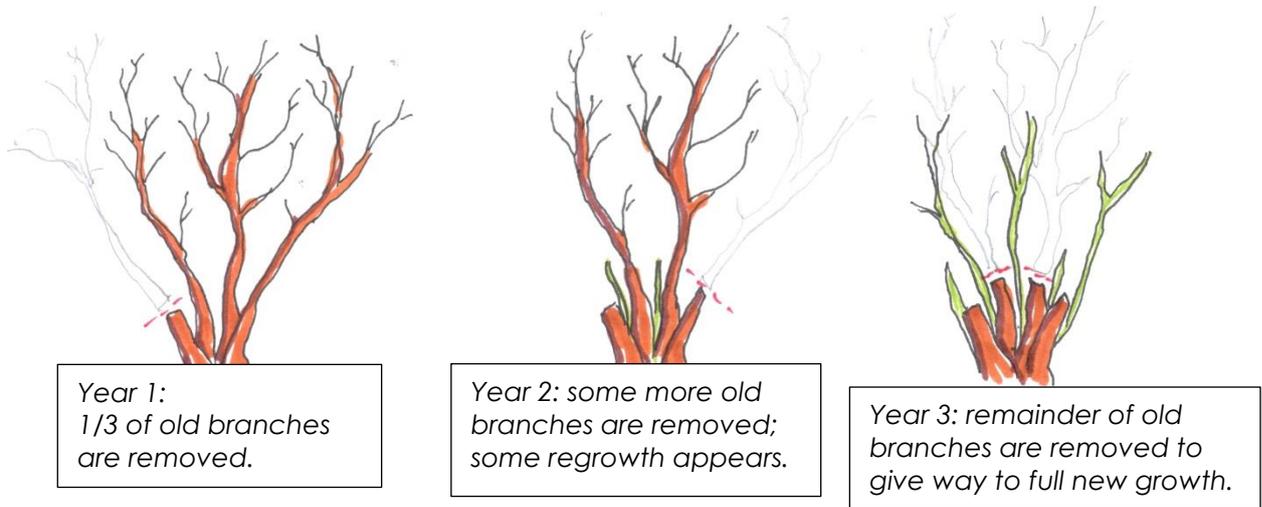


Figure 8. Steps of gradual rejuvenation pruning

Extensive rejuvenation pruning (stumping):

For extensive rejuvenation pruning all branches 30cm above ground are pruned. The tree will usually respond by growing new shoots.

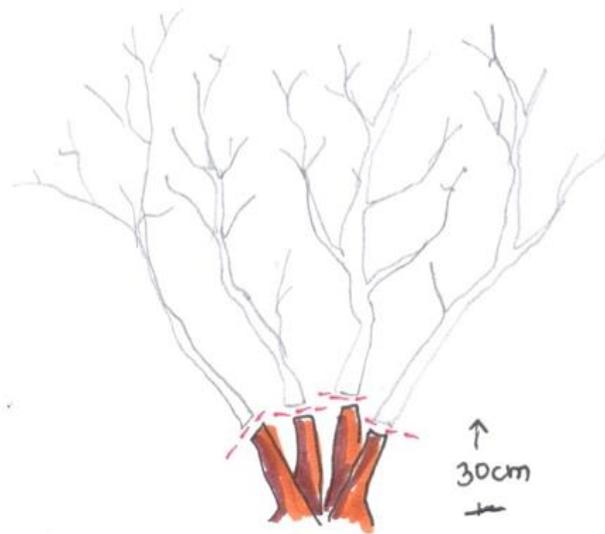


Figure 9. Complete removal of all old branches (stumping)



Pruning tools

Tools suitable are those that make clean cuts, leaving the wound as small and as smooth as possible. They should also allow for making cuts at a 45° angle to avoid rot. Recommended tools for pruning are: bow saw or a pruning saw, and sharp secateurs (for sucker removal). Tools should be disinfected after pruning each tree to avoid the spread of diseases from one tree to another. This can be done with disinfectant wipes, or by spraying with or dipping them in 70% ethanol/spirit. A 20% bleach or hydrogen peroxide dilution can also be used, but is more corrosive. After use, tools should be cleaned and oiled to prevent rusting.

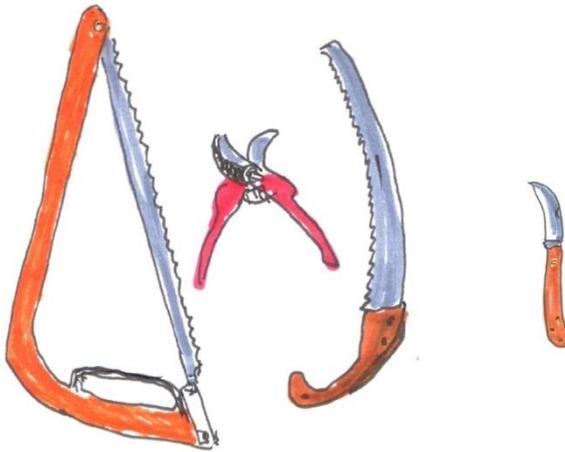


Figure 10.
From left to right:

Bow saw
Secateurs
Pruning saw
Pruning knife



Mandatory Smart Meter 4.2.2

Producers carry out pruning according to the requirement in 4.2.1.

Indicator: *% of group members that adequately prune according to crop needs, agro-ecological conditions², and applicable pruning guidelines.*

Objective

Once adopted, a pruning cycle should be implemented with the appropriate amount of skill and continuity to maintain plantation health and a profitable production potential.

Applicability

This core requirement is only applicable to Group management and large farms within group certification and to individual Certificate Holders. Group management is responsible for supporting its members in the implementation of the pruning cycle.

Specific guidance

Please refer to the next chapters for specific guidance on tea, coffee, and cocoa.

² The term agro-ecological conditions refers to the context of the ecosystem in which agriculture takes place. These are climatic conditions like temperature, seasonality, and rainfall, but also elevation, landscape, and soil type. A classification of the different agro-ecological climate zones can be found here: <http://www.fao.org/nr/gaez/en/>. Pruning cycles and practices need to take the particular conditions of the location into consideration.



3. PRUNING GUIDANCE FOR TEA

The pruning of tea consists of formative pruning, maintenance pruning, and corrective pruning depending on the life stage of the bush.

The time of pruning and length of the pruning cycle differs depending on climatic conditions, variety, and the kind of tea produced, etc.

The objective, however, is always to give the plant a low, wide framework of branches that will produce many leaves each year. Pruning directs the tea plant's energy towards new tea leaf growth. In tea pruning, it is essential to maintain high yields and quality.

Benefits of pruning tea

- Increased yield and improved quality of tea leaves.
- Maintenance of a convenient height of the bush to facilitate plucking operation.
- Induces leaf growth and keeps bushes in a vegetative phase.
- Stimulates the growth of vigorous, leafy branches through continuous replacement of old unproductive branches.
- Minimized formation of banji (sterile) shoots in the plucking table.
- Removal of crammed and crossing branches.
- Increased aeration and light penetration.
- Improved pest and disease control as well as plant health.

Natural growth habit of a tea bush:

Cultivated tea is largely known in two varieties, *Camellia sinensis* var. *sinensis* and var. *assamica*. The var. *sinensis* is a dwarf, shrub-like, slow-growing bush, while the Assam type is a tall, quick growing tree. Through periodic pruning every 3-5 years, both varieties are trained into a low, flat bush to maintain a plucking table at the height of 0.6-1.2m.

Primary shoots develop from buds on the pruned branches. A scheme of the branches/leaves that develop after pruning is given below. From the axils of leaves on primaries branch laterals develop, which, when plucked, give rise to the second and third-order laterals, etc. Eventually, a sterile bud is produced, the *Banji*, that needs to be pruned off to induce new growth.

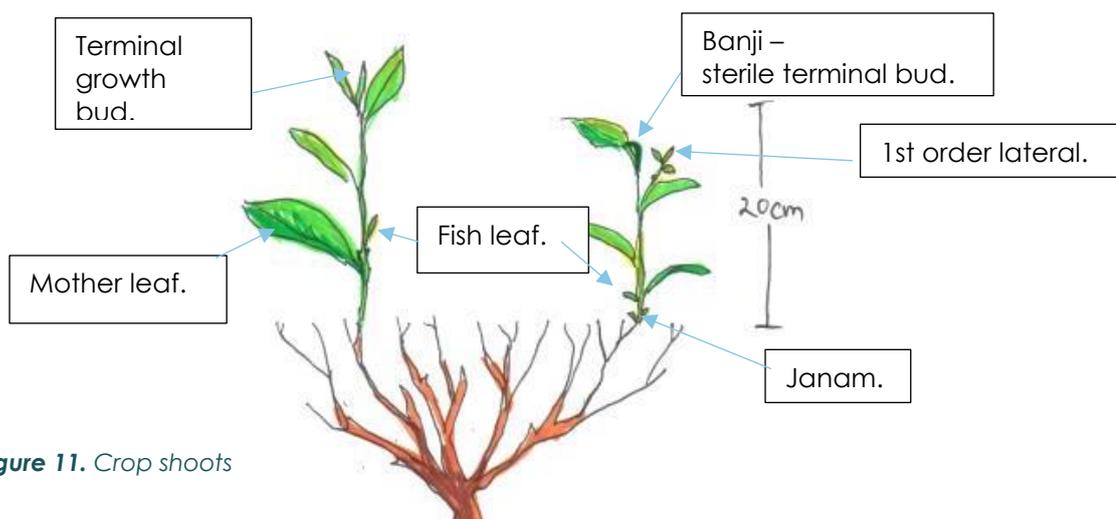


Figure 11. Crop shoots



The aim of trimming young tea plants is to develop a good permanent frame during the formative years for sustained high yield. This frame is then maintained during the entire life span of the bush, unless it requires rejuvenation due to disease or other damage. An ideal bush frame should be wide and compact, with an adequate number of uniformly thick and distributed branches.

Formation pruning:

Formation pruning consist of various operations, which are carried out during the initial 4-5 years after planting:

- Starts with **de-budding** in the nursery 4-5 days before planting:
Buds from the leaf axils above 20 cm from the ground are removed to suppress central dominance and induce growth of side branches from below.
- It is followed by **decentering** 3-5 months after transplanting when the plant makes a flush of growth:
The main stem is removed at a height of about 0.2m from the ground leaving 8-10 matured leaves. The cut should be made at a 45° angle. The removal of the main stem will induce the growth of more side branches.

Figure 12. Decentering



- If the plant does not have side branches, **thumb breaking** is done:
The single stem is held between the thumb and index finger at a height of about 0.2m from the ground and the stem is broken in such a way that the tissue is left intact but the stem is bent down. This encourages development of side branches from below the point where the stem is broken. The top portion of the stem is removed once new side shoots have developed.

Note: if the broken top of the stem does not remain facing downwards, shoots will develop in the top part.



Figure 13. Thumb breaking



Figure 14. New side shoots develop



- In East Africa, **pegging/bending** is sometimes practiced:
It describes the pegging and bending down of the main stem and/or side branches at an angle of 60-70° to encourage the development of more side branches.
- **Frame forming prune:**
In the first pruning (about two years after planting), the main stems are thinned at a height of 0.25m above the ground and headed at a height of 0.4m.
The second formative pruning is done one year later. Crowded branches are thinned and the bush is headed at the height of 0.45m.

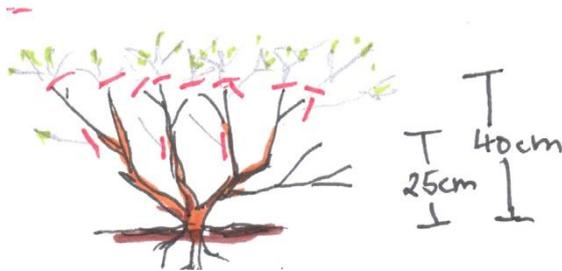


Figure 15. 1st pruning

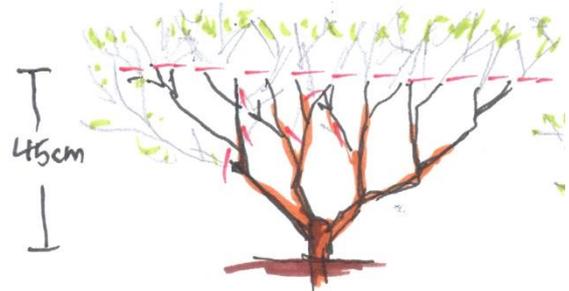


Figure 16. 2nd pruning

- **Tipping:**
After new shoots have grown 0.2-0.3m above the pruning level, they are broken off at a height of 0.6-0.7m, which is the **tipping level (TL)** to form a flat canopy, the so-called **plucking table**.

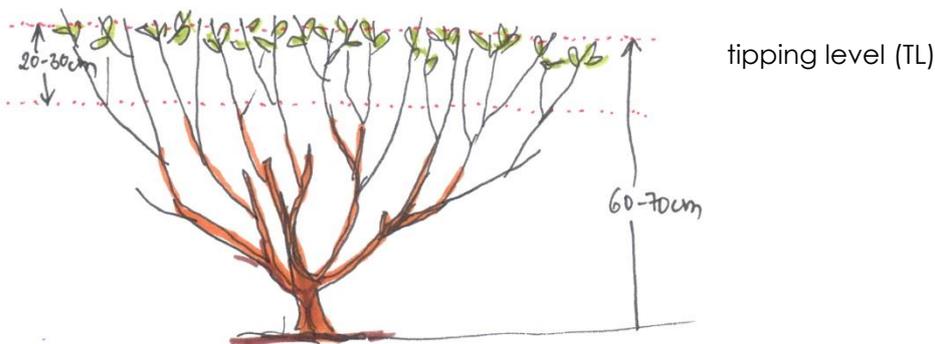


Figure 17. 3rd pruning

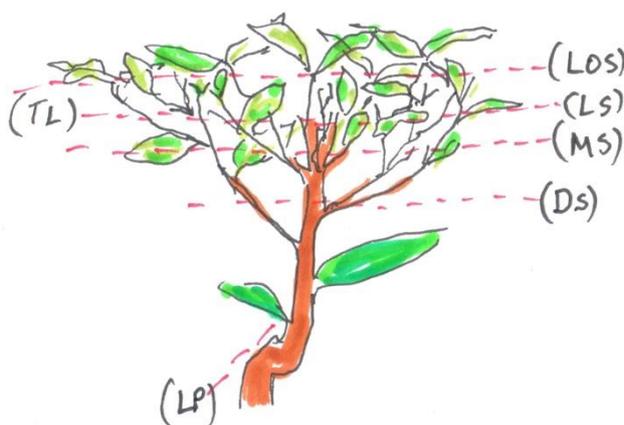


Maintenance pruning:

- The best time for pruning is during dormancy or when its growth rate is the slowest as energy reserves in the roots at that point are high. This improves recovery after pruning. The best time for pruning may differ with cultivars and might need to be ascertained by a root starch reserve test.
- If bushes have inadequate foliage, plucking is stopped three weeks before pruning.
- Very weak tea plants and those due for medium pruning (MP) should be rested 5-8 weeks prior to pruning to avoid mortality.
- **Light pruning (LP)** describes the heading of tea bushes every 3 or 4 years at 4 -5 cm above the last pruning cut.

Skiffing:

Skiffing describes a lighter cut into green wood only. It is done to induce a new flush, or when the plucking table rises so fast or irregularly that it becomes necessary to slightly cut it back. Tea bushes may be deep skiffed (DS), medium skiffed (MS), light skiffed (LS) , or just leveled off (LOS).



Level of skiff (LOS): 4-6cm above the tipping mark (to level the plucking table).

Light skiff (LS): at tipping level (TL) or up to 1 cm above the previous TL.

Medium skiff (MS): 5cm over last deep skiff mark.

Deep skiffing (DS): between 12-15cm above the last LP mark.

Figure 18. Different levels of skiffing



Corrective pruning:

- Tea bushes that have grown too tall so that plucking becomes difficult, are **medium pruned (MP)** to a level of 0.45-0.6m above the ground. MP also helps to rejuvenate the bush, prevents yield decline, and removes unproductive excess woods. Medium pruning is therefore, an opportunity for taking corrective measures for improved health and productivity.
- A **heavy prune (HP)** for complete renewal of the frame. The bush is cut down completely at 0.15-0.45m above the ground. This can only be done when the root system is strong enough to initiate new growth, as it often results in mortality.
- When frames are severely diseased or consist of too much deadwood, they need to be rejuvenated. **Rejuvenation pruning** is the most severe pruning type, where the bush is cut down at ground level. It is not a routine activity but only done when needed. Gap filling can take place at the same time.

Pruning cycle³:

Depending on cultivar and climatic conditions, a 3-4 year or 4-5 year pruning cycle can be suitable as it provides a more even distribution of crop than an annual prune. A prune is followed by lighter forms of cut (skiffing) or unpruned (UP) until the bushes are pruned again. However, the cycle of pruning should be such that the branches remain uniformly thick. Depending on vigor and age of bush, 4-year cycles can be repeated once or twice, while 3-year cycles can be repeated up to three times.

Precautionary measures to prevent mortality:

- Potassium fertilizer has a great influence on the recovery of bushes from the pruning. Potassium fertilizer and manure are usually applied before pruning.
- Prevent sun scorch by providing adequate shade.
- Avoid infestation of pests that would weaken the plant.
- During medium prune, one or two **breathers/lung shoots** can be left on the southwest side of the bush. They are cut back after the new flush of shoots on the bushes has produced some leaves.

³ Examples of pruning cycles:

a) Shaded, young and vigorously growing tea: LP-UP-UP (improves yield); b) normal tea growing areas LP-UP-DS-UP; c) Droughty areas or for younger, mature tea after final frame forming prune and in old tea after bush frame rectification LP-UP-DS/LP-DS-UP; d) LP-DS-MS- (to improve quality); e) Darjeeling (low elevation) LP-UP-DS-UP; f) Darjeeling (mid & high elevation) LP-UP-UP-DS-UP; g) LP-UP-MS-UP.



4. PRUNING GUIDANCE FOR COFFEE

Pruning of coffee trees is one of the major activities in a coffee plantation. It is carried out to remove broken, dead, unproductive, aged, diseased, and pest-damaged branches or stems, as well as non-productive suckers. It consists of formation pruning, which can be done as single-stem or multi-stem pruning, fruiting or maintenance pruning (including de-suckering), and finally, rejuvenation pruning. The pruning regime might differ regarding the type of coffee grown. The purpose however, must always be to achieve a robust tree with a well-balanced framework, which can support branches with many leaf-bearing nodes capable of producing a good crop at a convenient height. In coffee, pruning is also done to maintain the health and longevity of the tree and to improve berry quality. Pruning, however, does not necessarily increase overall productivity, but pruning can be a means to reduce harvesting/labor costs per sack.

Benefits of pruning coffee

- Balance between optimum yield and quality of coffee beans.
- Removal of weak branches that produce only minimal yield but compete for soil nutrients.
- Better aeration for reduced fungal disease pressure.
- Reduced height for better access during harvest and pesticide applications.
- Reduced dieback caused by over-production.
- Trees stay vigorous and productive for longer.
- Improved pest and disease control.

Natural growth habit of coffee trees:

Coffee has an erect growth habit, which can be single-stem or multi-stem. The primary branches grow in opposite pairs spiraling up the main stem. Depending on the variety, their nature can be erect, spreading, or even drooping. On the primary branches, slender secondary branches develop – or tertiary branches in the case of Arabica coffee. Although a branch can bear fruit for several years, it does not flower again from old nodes. Flowers and fruits are only produced from nodes on the leaf axils that were created during the preceding rainy season. Vertical, non-productive water shoots, so-called suckers, usually develop from the main stem. Primary branches that have been pruned off will not grow back. New growth can only be initiated from these vertical shoots.

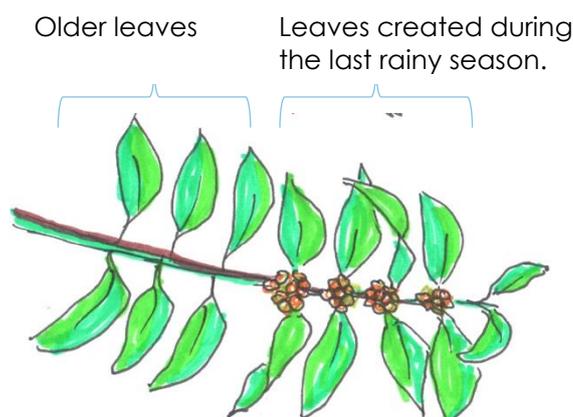


Figure 19. Fruiting habit of coffee

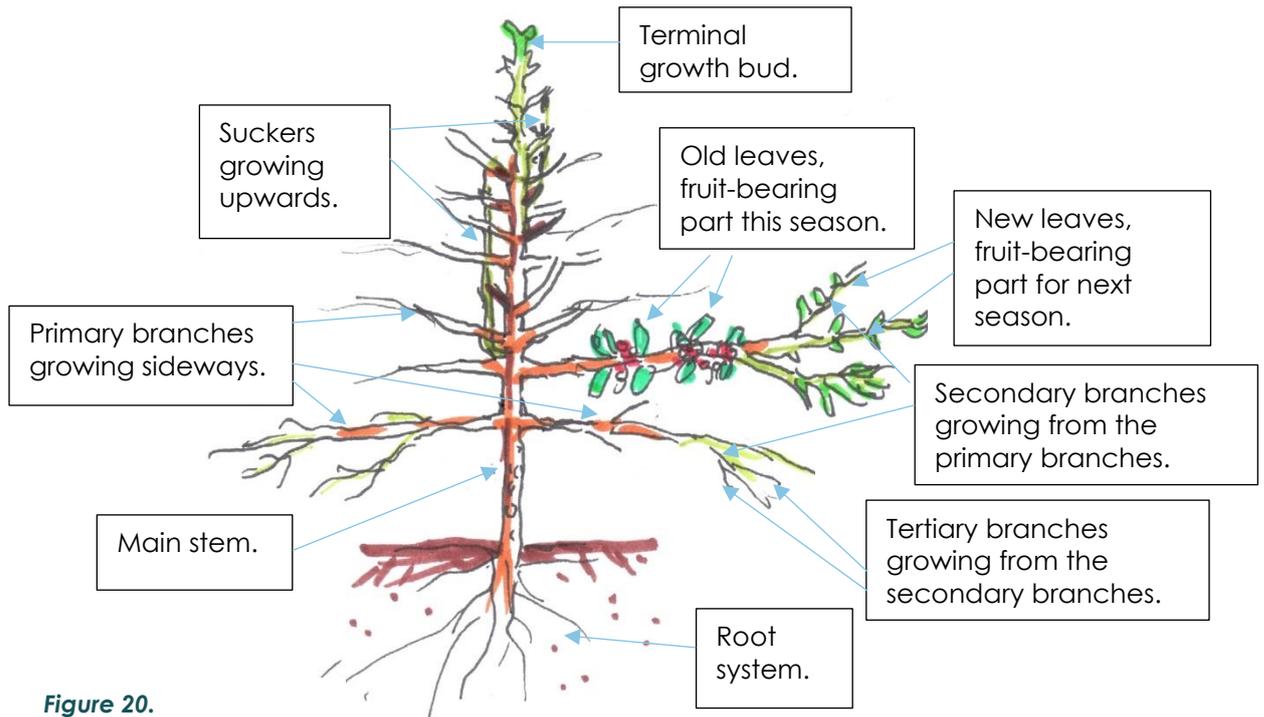


Figure 20.
Parts of a coffee tree

After approximately one year the young tree has developed 4-8 pairs of branches. The annual growth pattern follows the climatic alteration between dry and rainy seasons, with vegetative dormancy during the dry season and flowering being induced by rain.

The first crop can usually be harvested in the third year. The tree is considered fully mature in the 5th or 6th year. From the 7th year the tree starts to lose vigor and eventually goes into a vegetative decline phase, also called senility. At an age of 25-30 years a tree is usually no longer commercially viable, although with good management (high organic matter levels of 3.5% playing the most important role), a tree can still be productive at the age of 100 years. If unpruned, a coffee tree will grow to a considerable height (up to 15m), bearing fruits in clusters out of reach for harvesting. Branches become long and lose their older leaves after fruiting, becoming more and more straggly, eventually dying back along the central part of the tree, leaving only dead stumps and non-productive suckers. Such a neglected coffee tree is weak, short-lived, produces low-quality berries and is prone to pest and disease attack.



De-suckering:

De-suckering describes pruning where a number of suckers (water shoots) that grow from the main stem are removed with a thinning cut using secateurs.

The sucker is cut off directly on the stem without leaving a stub to ensure that no new suckers will grow from the cut.



Figure 21. De-suckering cut

De-suckering is done to check excessive growth to avoid competition from too many suckers and thereby enhance productivity. Too many suckers weaken the coffee tree because the tree is wasting energy on shoots that are not required for coffee berry production. De-suckering also opens-up the canopy for better aeration and light penetration. It can be done after harvests several times during the year, while the suckers are still soft.

Rejuvenation involves cutting down very old and unproductive stems to enable new shoots to grow to start a new production cycle. It can be done as complete stumping or as a staggered process. Rejuvenation must always be accompanied by good agricultural practices (mulching, fertility management, de-suckering, shade management, irrigation where necessary, etc.) to strengthen the new shoot so that it can become productive quickly and to prevent continuous early decline. To promote early regrowth rejuvenation pruning should happen as soon after harvest as possible. Larger cuts can be covered with tar to avoid pathogens entering the wound. Rejuvenation usually leads to higher light intensity in the plantation, causing increased weed growth. During the period directly following rejuvenation pruning extra attention should therefore be given to weeding or mulching.

Renovation of coffee describes the complete uprooting of old unproductive trees and re-planting with new high-yielding, disease and or climate tolerant varieties. Complete renovation might be necessary where pests or diseases have irreversibly affected trees, better-adapted varieties are available, and yields warrant the renovation. Plantations that comprise of trees older than 40-50 years should perform a staggered renovation by replacing a percentage of the oldest and least productive trees every season.



4.1 ARABICA COFFEE (COFFEA ARABICA)

Specifics of Arabica coffee:

- Flowering starts with the beginning of the rainy season.
- Prone to annual alternation between high and low yields.
- A large portion of the crop is grown on secondary branches.
- Usually grown as a **single stem**.
- Single-stem pruning is labor-intensive and requires considerable skill/experience.

Formation pruning:

- Starts with **capping**: when the young tree has reached a height of about 1.8m the terminal growth bud is cut off. Capping can also be done successively, each time only retaining the single strongest of the suckers that have developed.

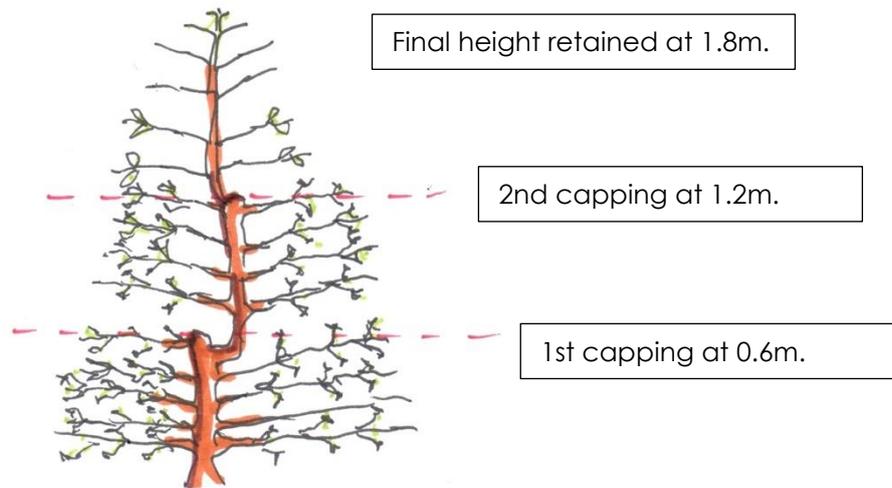


Figure 22. Successive capping stages in single-stem pruning

- To avoid fanning out, one of the two terminal primary branches is removed.
- The lowest primary branches that are less than 30cm from the ground are removed.
- Primary branches that are too close together (less than 15cm from each other) are reduced by removing the weaker of the two, retaining 40-50 primary branches per full-size tree.
- Suckers that grow vertically from the main stem are removed.
- Secondary branches growing from the first two nodes closest to the main stem are removed.
- Secondary branches that do not grow in the desired direction are removed, retaining 2-10 well-spaced lateral branches per primary branch.



Annual fruiting/maintenance pruning:

- “Fly crop” fruit (early fruit which competes with strong plant/root development) are removed as they appear. The first proper harvest should take place in year 3.
- Suckers are pruned off regularly, especially during the rainy season, as capping induces sucker development.
- After the first harvest, most fruit will be produced on the secondary branches. To maintain high productivity, weak or over-long secondary branches that have already produced fruit are cut off.
- Terminal growth buds on the primary branches are cut off to stimulate the growth of new secondary branches.
- Secondary branches are cropped to a length of 0.6m.
- Dead or diseased wood is removed.
- Drooping primary branches that touch the ground are cut back to the first secondary branch.

As an alternative to single-stem pruning, the **programmed pruning cycle** has been proven⁴ to be economically viable for smallholder farmers. In this pruning regime, 12,000 to 15,000 stems are maintained per hectare. The number of stems per plant therefore depends on the spacing of trees. The stems are maintained for 3-4 harvests, and from that point about 50%-75% of them are removed in order to allow light and air to enter the central part of the plant, initiating the growth of new, more vigorous shoots. The remaining old stems are removed after the next harvest. This method requires considerably less labor and expertise.

⁴https://www.researchgate.net/publication/323961756_Feasibility_and_Economic_Risk_of_Programmed_Pruning_Cycle_in_Arabic_Coffee



In East Africa, Arabica coffee trees are sometimes kept as **modified multi-stem**. In this system the main stem is also capped at a height of 0.5-0.6m but two or more shoots are retained.

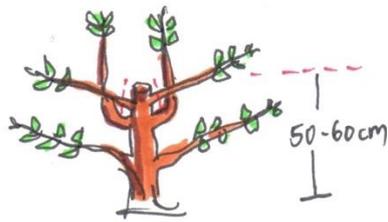
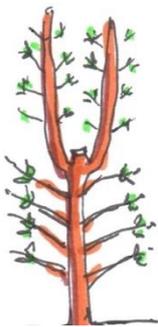
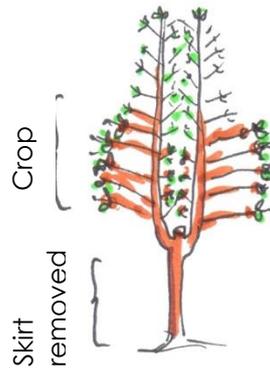


Figure 23. Pruning stages of coffee

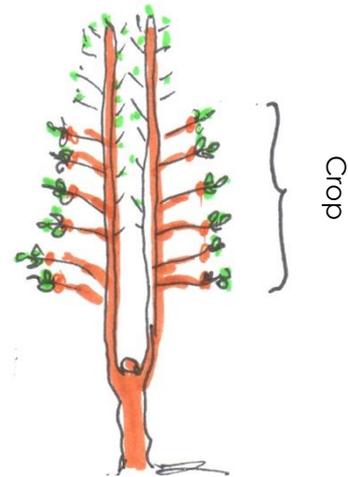
Stage 1: the tree is capped, and two or more shoots are retained. The primary branches above the shoots are removed.



Stage 2: shoots develop into multiple stems



Stage 3: lower primaries (skirt) removed



Stage 4: optimum yield stage

Rejuvenation:

- Every 6-7 years (depending on tree vigor and yield), start a new production cycle on renewed wood to avoid decline.
- Two rejuvenation methods are used: side pruning or stumping.
- **Side pruning** describes the removal of all branches on the eastern side of the tree, and training a new sucker chosen from 30-40cm above the ground to become the new main stem, followed by complete removal of the old stem just above the new stem. The pruning cut should be made at a 45° angle.
- **Stumping** is the complete cutting back of the old stem/trunk to a height of 0.3 – 0.5m from the ground and developing a new stem from the stump. This usually causes a total crop loss for the following two years.



4.2 ROBUSTA COFFEE (*COFFEA CANEPHORA*)

Specifics of Robusta coffee:

- Flowering is induced following sudden rains during the dry season.
- Flowers on primary branches only.
- Usually grown as **multi-stem**.
- Multi-stem pruning is less labor-intensive but leads to yield variations (three good harvests followed by two small yields).

Formation of seedlings – successive formation pruning:

- The seedlings are planted at an angle of 30°.
- In the first step, after six months, six shoots are selected; all others are removed completely.
- Plants that have not developed shoots are bent down and pegged to the ground. The terminal growth bud is cut off.
- Two months later, the number of shoots is reduced to three or a maximum of four to maintain optimum productivity. These are retained as multiple stems.

Fruiting/maintenance pruning:

- Successive regular removal of suckers during the rainy season.
- Weaker and aging lower primaries are removed. Any diseased, infested, or dead branches are pruned off.
- Branches close to the ground are also removed to avoid pest and disease infection.

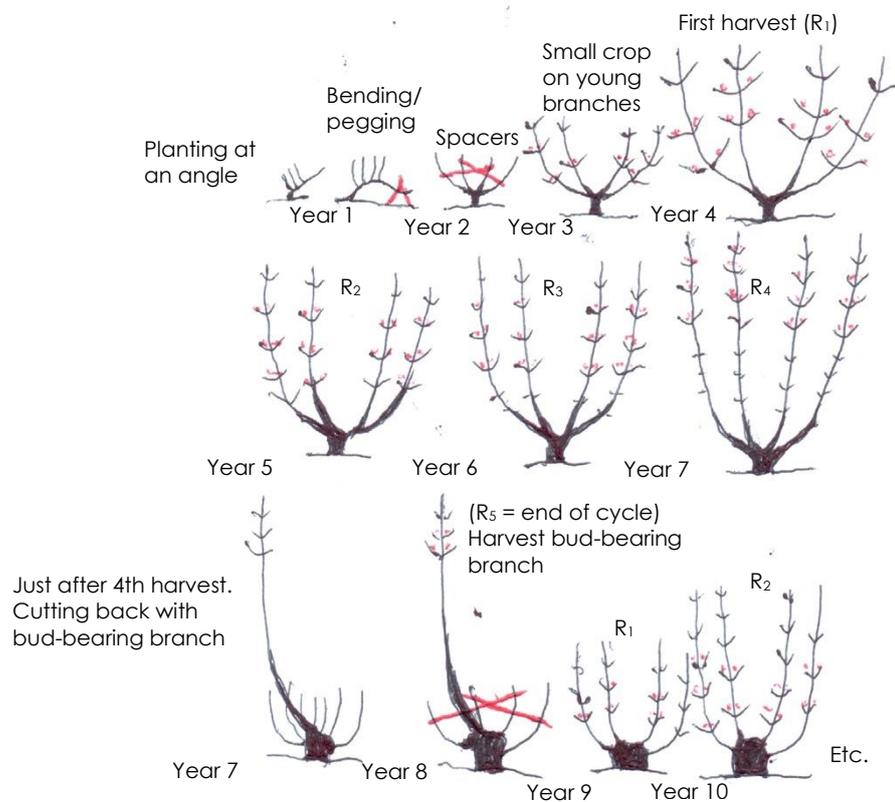


Figure 24. Multiple-stem pruning cycle



Rejuvenation:

- After 7-8 years or after every 4th-5th harvest.
- During the dry season, all but one stem (called “breather” or “lung”) is cut back to 0.3m from the ground. This can be done with a chainsaw, but the cut should be clean, and care should be taken not to rip off bark from the remaining stem. Use of a machete is not recommended. The cut should be made at a 45° angle.
- Three months after stem removal up to six new shoots can be selected and thinned out to 3-4 shoots that are vigorous and evenly distributed.
- After the next harvest (one year later), the remaining old stem is removed.

5. PRUNING GUIDANCE FOR COCOA

Benefits of pruning cocoa

- Height control to facilitate access
- Production of a strong and well-balanced framework of branches
- To maintain the balance between vegetative growth and fruit production
- Improved aeration for better disease control
- Assistance in control of Cocoa Pod Borer (CPB)
- Removal of diseased or damaged parts

Natural Growth habit of cocoa trees:

The cocoa tree has a single erect stem/trunk. At about 1.5m above ground a **jorquette** forms a crown of 3-5 main/fan branches. After a phase of lateral growth, the elongation of the trunk recommences when a new **chupon** (watershoot) grows out of lateral bud below the **jorquette**. This new growth is usually vigorous, traverses the whorl of branches and gives rise to a new tier of branches 1-2m above the first tier or even higher under shade conditions.

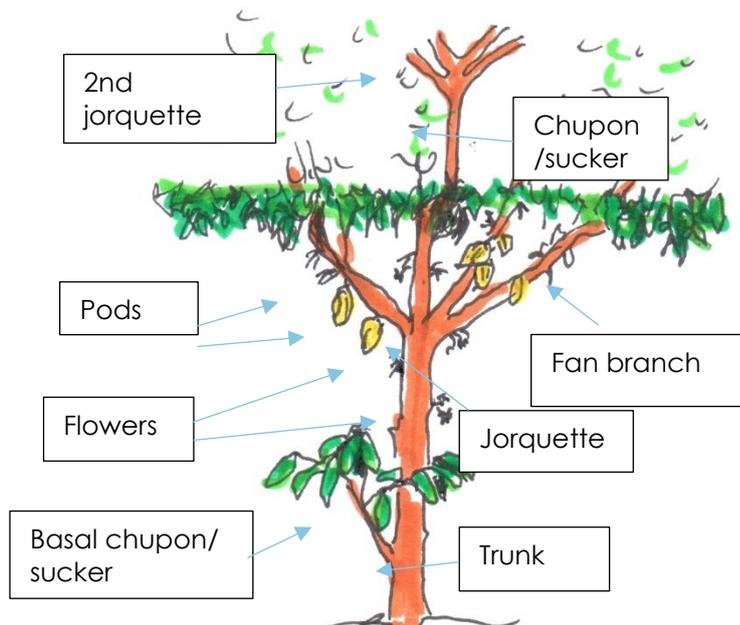


Figure 25. Parts of a cocoa tree



If uncontrolled, this growth pattern continues for 5-6 tiers growing up to 10m high. For better accessibility during pest and disease control and harvest but also to improve yields, the growth of cocoa is controlled through pruning. Pruning of cocoa trees consists of formative and sanitary/maintenance pruning. Sometimes rejuvenation pruning might become necessary. In cocoa plantations shade trees also need to be managed by pruning.

Formative pruning:

- Removal of any excess shoots to leave only the strongest for stem formation.
- Regular removal of the lowermost branches at regular intervals so that the remaining main branches develop at a convenient height.
- If the crown forms at less than 1m height, choose a shoot which grows straight up and let it develop into a new crown at a good height.
- Removal of weak fan branches leaving 3-4 equally spaced fan branches few months after the formation of the *lorquette*.



Sanitary/maintenance pruning:

- Removal of low-hanging branches.
- Removal of all shoots and secondary branches within 0.6m from the *lorquette*.
- Maintenance of a goblet shape of the crown to allow sunlight to trickle through to the *lorquettes* for stimulation of flowers, but avoid exposure or holes in the crown canopy that would attract mirids (insects).
- Regular (quarterly) removal of dead, damaged or diseased branches.
- Regular (monthly) removal of chupons (suckers) on the stem to retain strength for pod production.
- Top pruning at a maximum height of 4m to keep the tree manageable.

Heavy pruning is best done after the high production cycle, around one month before the rainy season or main flushing season.

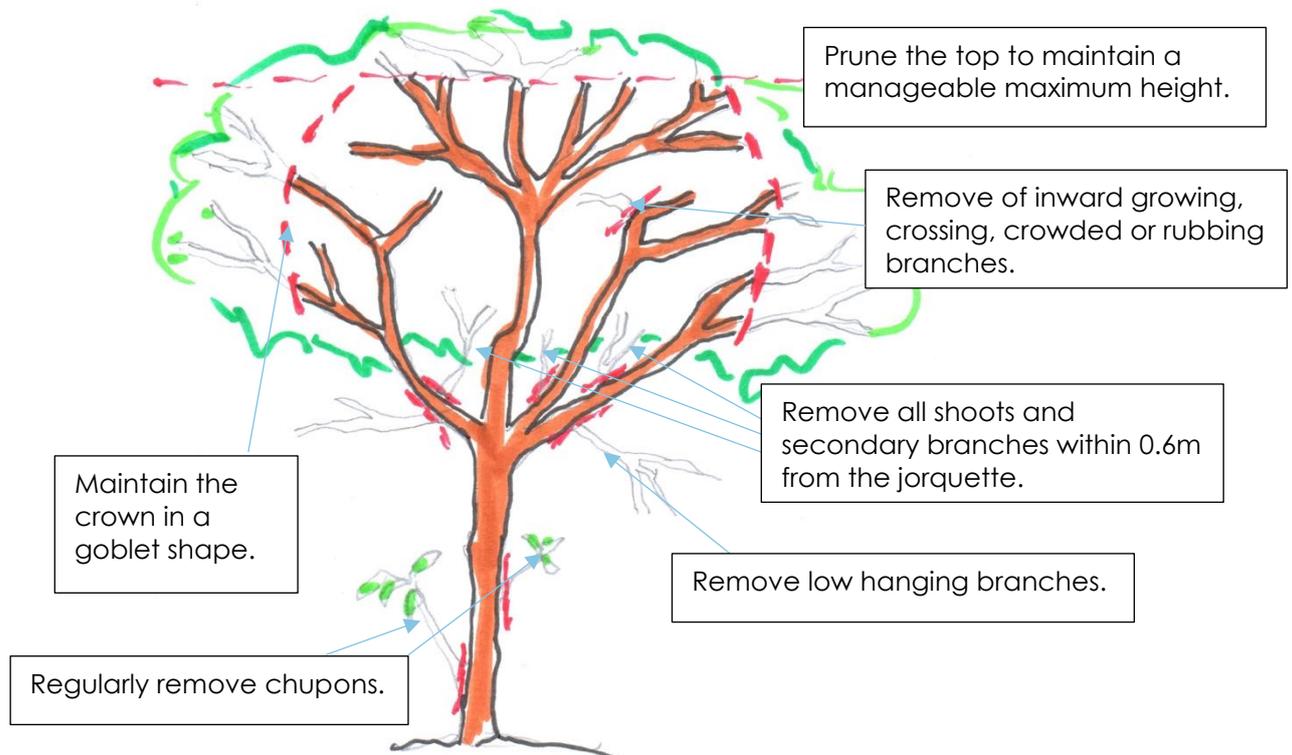


Figure 26. Different pruning cuts in cocoa

Rejuvenation:

Aged cocoa trees produce very low yields. They can be brought back into productivity through rejuvenation pruning.

- Retain one or two chupons that develop low down on the stem and let them grow.
- When they reach sufficient size remove the old stem.

Shade tree pruning plays an important role in cocoa growing.



6. PRUNING-RELATED DEFINITIONS

Banji “sterile”: refers to two leaves without a bud or two leaves and a dormant bud.

Flush: The new shoot of a tea bush consisting of two leaves and a bud as plucked for quality teas. It takes an average of 40 days for a leaf bud to develop into a shoot containing a full complement of leaves, which is known as a flush.

Janams: The axillary bud, while unfolding, generally produces in succession two scales, a small foliar structure in the shape of a thumb also called Thumb leaf.

Jorquette: The vertical growth of a chupon or main stem terminates in a whorl, the jorquette, where 4-5 laterally growing fan branches develop.

Skiffing: A slight cutting back of green wood on a tea bush to induce a new flush, or to level off the plucking table.

Sucker/chupon/watershoot: A vigorous but unproductive shoot growing upright from the trunk, main branch, or root of a tree. Sometimes also growing from a pruning cut. In cocoa, it can grow from underneath a jorquette and be trained into a new main stem.

Fan branch: Side branches that grow almost horizontally from the jorquette.

Goblet shape: In the shape of a goblet, a particular kind of cup/glass:

