

Technical Series
Extension Materials No. 6



The Life Cycle and the management of the Cacao Orchard

Eduardo Somarriba Chavez · Rolando Cerda Bustillos · Francisco Quesada Chaverri
Carlos Astorga Domian · Luis Orozco Aguilar · Marilyn Villalobos Rodriguez
Shirley Orozco Estrada · Alexander Corrales Mora · Romina Villegas Caceres
Eduardo Say Chavez · Olivier Deheuvels

Tropical Agricultural Research and Higher Education Center (CATIE)
Turrialba, Costa Rica
2012

The Tropical Agricultural Research and Higher Education Center (CATIE) is a regional center dedicated to research and graduate education in agriculture, and the management, conservation and sustainable use of natural resources. Its members include the Inter-American Institute for Cooperation on Agriculture (IICA), Belize, Bolivia, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Venezuela, Spain and the State of Acre in Brazil.

633.743

L722 The life cycle and the management of the cacao orchard / Eduardo Somarriba Chávez... [et al.] .

– 1° ed. – Turrialba, C.R : CATIE, 2012.

47 p. : il. – (Technical series. Extension materials / CATIE ; no. 9)

ISBN 978-9977-57-580-3

También como: Collection field schools ; no.6

1. Theobroma cacao – Ciclo vital – Materiales de extensión 2. Theobroma cacao – Plantaciones – Materiales de extensión I. Somarriba Chávez, Eduardo
II. Cerda Bustillos, Rolando III. Quesada Chaverri, Francisco IV. . Astorga Domian, Carlos
V. Orozco Aguilar, Luis VI. Villalobos Rodríguez, Marilyn VII. Orozco Estrada, Shirley
VIII. Corrales Mora, Alexander IX. Villegas Cáceres, Romina X. Say Chávez, Eduardo
XI. Deheulves, Olivier XII. CATIE XIII. Título XIV. Serie.

Credits:

Authors:

Eduardo Somarriba Chavez
Rolando Cerda Bustillos
Francisco Quesada Chaverri
Carlos Astorga Domian
Luis Orozco Aguilar
Marilyn Villalobos Rodriguez

Shirley Orozco Estrada
Alexander Corrales Mora
Romina Villegas Cáceres
Eduardo Say Chavez
Olivier Deheulves

Editing:

Shirley Orozco Estrada
Marilyn Villalobos Rodriguez

Technical Review:

Phillippe Lachenaud
Aroldo Dubon Dubon

**Illustration,
design and arts:**

Alexander Corrales Mora

Coordination:

Shirley Orozco Estrada

This manual was developed to serve as support material in education and information processes about the management of grafted cacao plantations. Funding was provided by the World Cocoa Foundation (WCF) and the Royal Norwegian Embassy through the Project for Competitiveness and Environment in the Cacao Territories of Central America (Central American Cacao Project), an initiative of the Mesoamerican Agroenvironmental Program of CATIE.



Good morning.

Good morning, come on in.

It's great you got here early.

We came early to seize the day.

We didn't want to miss out on the invitation to see your cacao plots and learn new things.



And are you providing lunch?

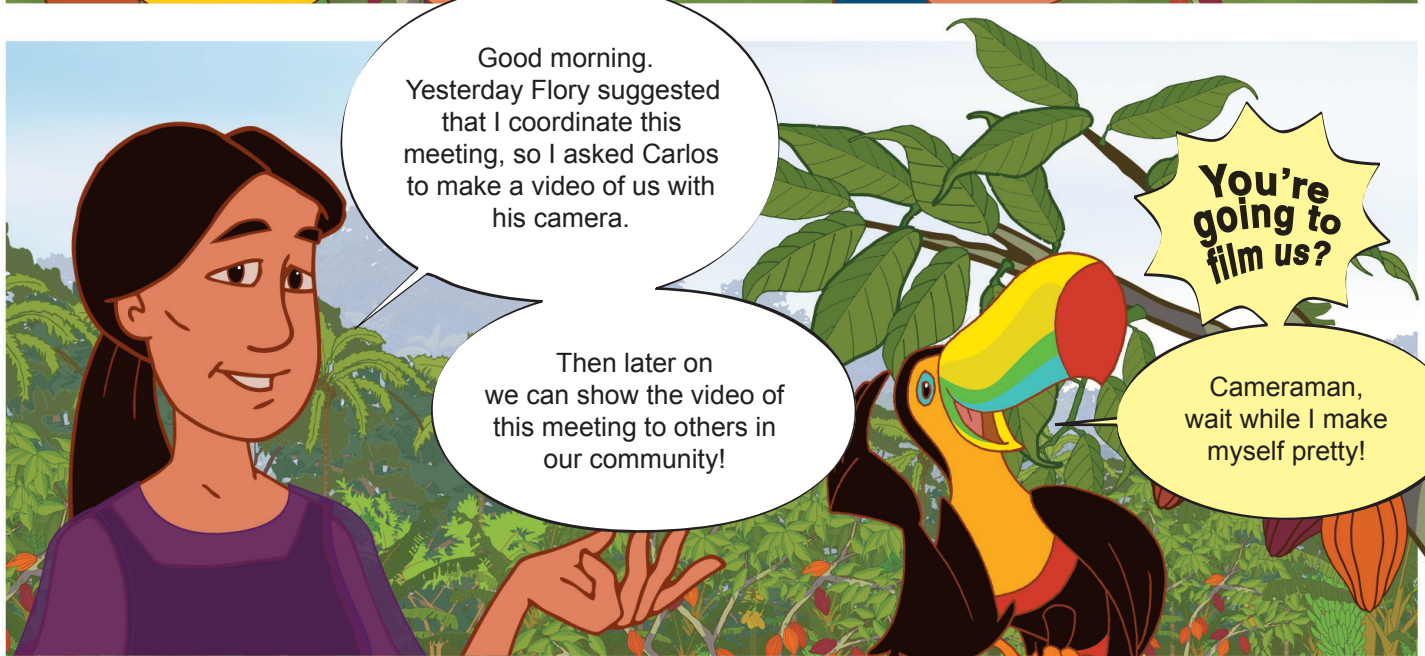
Yikes, I thought you came because you wanted to learn new things, but I see that your main interest is filling your belly!



Today we will talk about how to manage the cacao plant during its life cycle.

I propose that Cecilia lead the meeting; she knows a lot about cacao and has traveled to other countries and seen many kinds of **cacao farms**.

She will also help us make a booklet based on what we talk about here, like we've done in other meetings.



Good morning. Yesterday Flory suggested that I coordinate this meeting, so I asked Carlos to make a video of us with his camera.

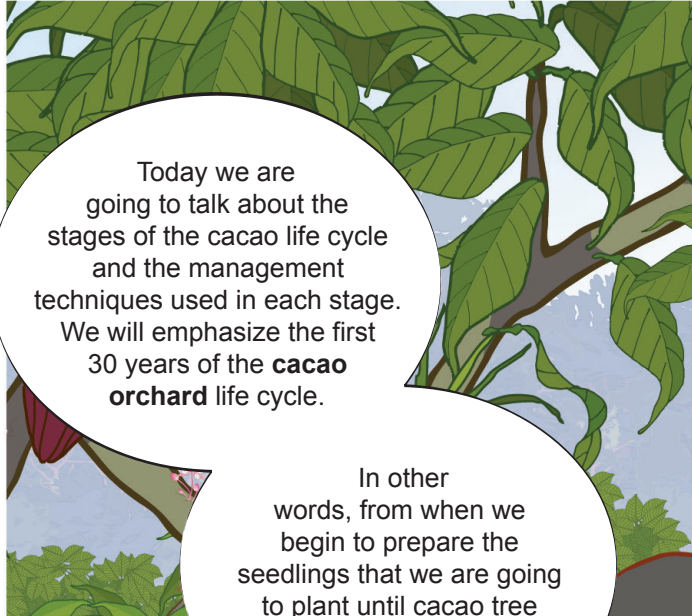
Then later on we can show the video of this meeting to others in our community!

You're going to film us?

Cameraman, wait while I make myself pretty!



Tell us, Cecilia, what topics are we going to cover in the meeting?



Today we are going to talk about the stages of the cacao life cycle and the management techniques used in each stage. We will emphasize the first 30 years of the **cacao orchard** life cycle.

In other words, from when we begin to prepare the seedlings that we are going to plant until cacao tree production starts to decline.



Dear readers, When you see words written in **bold letters** as you read, this means that you can find the definitions of these words in the glossary at the end of this booklet.

A glossary is just a list of words in alphabetical order with their meanings explained.



Let's walk through the farm while we talk.

Today we'll see and talk about the management of the cacao orchard in several stages of its life, visiting several plots on this farm.

Managing a cacao orchard: Anyone want to explain what this means?

I can explain it.

Okay.



Managing something consists of knowing what to do and doing it at the right time in the right way.

For example,

I know what to do when I manage my bicycle. First, I have to know how to keep it balanced, then I have to pedal to go forward, know when to brake, how to lean to one side to make a turn, when I should inflate a tire or replace it because it's very worn, among other things.

Good explanation, Miguel.

OK then,

it's obvious that managing a cacao orchard well means doing activities on time and in the right way that will allow the cacao and the other plants of the cacao orchard to grow and produce.

Absolutely. Management activities for cacao orchards include: planting, grafting, pruning, weeding, harvesting, fertilizing, controlling diseases, regulating the shade, thinning the shade trees, recruiting others, just to give some examples.

Correct, but you have to know when to do each activity. Did you know that the management of the cacao orchard depends of the life cycle of the cacao plant?

Of course we know that. So, if we are going to talk about management, first we must learn about the stages of the life cycle of the cacao plant, from its birth to its death.

Let's have a look then at the stages of the life cycle of cacao. Then we'll look at how to manage the cacao in each stage.

Agreed?

THE LIFE CYCLE OF CACAO

Agreed! Your proposal is right on, Cecilia. I'll begin with an example.

We people pass through several stages during our lives: first we are children, then teenagers, then adults, then we get old and finally we die.

I'll give another example: the daily cycle in the life of the monkey. The monkey gets up in the morning, has breakfast, then sleeps, then eats again, then sleeps, then eats, and finally he goes to bed hungry until the next day.

Hey, are you insinuating that I'm lazy? Don't you know that I myself peel the bananas I eat?

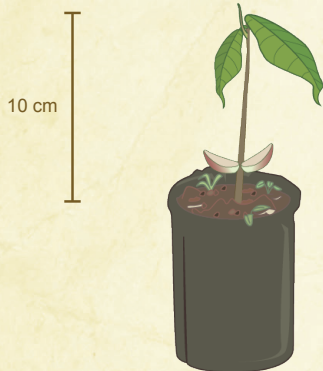
Yum!

Settle down and let's continue.

Cacao plants, whether **hybrids** or **clones**, pass through six stages in their life cycle. Look, I've written them here on this poster.



Stages of the life cycle of cacao



1. Preparation of material for planting (the year before planting).



2. Establishment in the field and early formation of the plant (years 1 to 3).



3. Development of the crowns and beginning of production (years 4 to 10).



4. Full production (years 11 to 30).



5. Decline of production (years 31 to 60).



6. Old age and death (61 to more than 100 years).



I didn't know that cacao trees could live so many years.



Of course they can. I am renewing some trees from my 75-year-old cacao orchard to see whether Alcides and I can finally get married.

My grandmother Petronila is going to be so happy when she finds out!

She loves weddings!

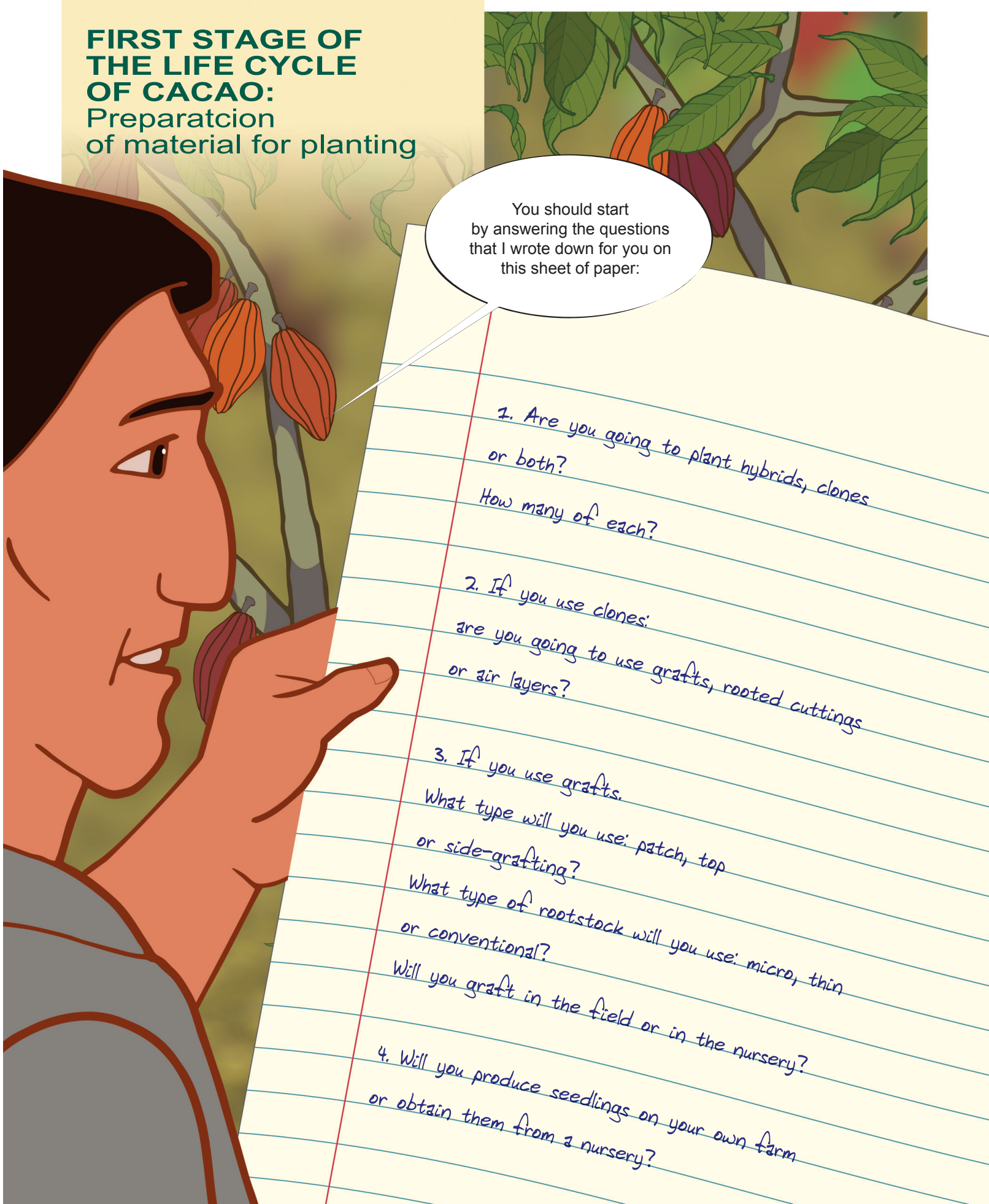
Let's talk about the management activities for cacao in each stage as we walk around the farm. When we want to plant cacao,

where should we begin?



FIRST STAGE OF THE LIFE CYCLE OF CACAO:

Preparatcion of material for planting



You should start by answering the questions that I wrote down for you on this sheet of paper:

2. Are you going to plant hybrids, clones or both?
How many of each?
2. If you use clones:
are you going to use grafts, rooted cuttings or air layers?
3. If you use grafts.
What type will you use: patch, top or side-grafting?
What type of rootstock will you use: micro, thin or conventional?
Will you graft in the field or in the nursery?
4. Will you produce seedlings on your own farm or obtain them from a nursery?

The material for planting

Planting material is what we call the type of cacao plants that the farmer will plant in the cacao orchard.

For example, if the farmer plants the cacao seed directly in the soil, the planting material is the seed.

If scions are grafted onto suckers in the field, using the bud grafting technique, then the planting materials are the scion together with the sucker, and both must be prepared.

If plants produced in the nursery in bags are used, the planting material is the plant in its bag.

Would you agree with me if I say that the answers to Filadelio's questions will vary depending on the objectives, future plans and economic conditions of each family?

I agree.

The answers also depend on the soils, rainfall patterns, the labor force available and many other important factors that vary from farm to farm.



I am a strong believer in planning. You must have a plan to ensure that the planting material will be ready when you are thinking about putting it in the field.

Let's look at this plot that they are preparing for planting cacao.

What do you see?



Since the timber shade trees here are still small, corn and **pigeon pea** have been planted to serve as **temporary shade** for the cacao seedlings during their first year of life.

Correct.


Right, with the advantage that these crops leave less space for weeds to grow.



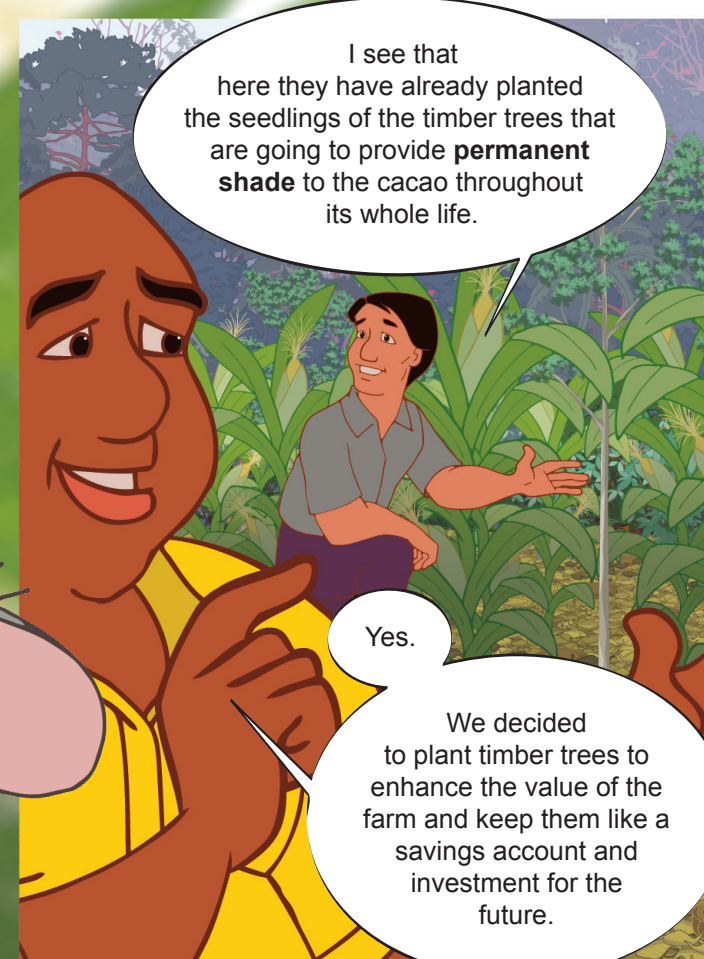
A good decision, because they can also use these crops to sell or to feed the family and the animals,

right?





I applaud this idea because weeds don't feed anything. But these crops will ensure me and my family a well-balanced diet!.



I see that here they have already planted the seedlings of the timber trees that are going to provide **permanent shade** to the cacao throughout its whole life.

Yes.

We decided to plant timber trees to enhance the value of the farm and keep them like a savings account and investment for the future.

We decided to plant **Spanish cedar** at 15 meters with 15 meters distance between the cedars. With these planting distances, 44 trees can fit in a hectare of cacao orchard.

And what kind of cacao planting material are you going to use?


We're going to use the grafts that we produced in a small nursery here on the farm. Let me explain better what we did, Alberto

In the first three months, while the temporary shade was growing, we produced the **rootstocks**,

then we grafted **buds** on and now we are pruning the ones that took hold in the nursery, to shape them before planting them in the field.


SECOND STAGE OF THE LIFE CYCLE OF CACAO: Establishment in the field and start of plant formation





That's right.
But also understand that
before taking the seedlings
to the field, the farming
family has to make
three very important
decisions:

- 1) Select the site where the cacao will be planted.
- 2) Set the **planting density**, meaning the distance the cacao plants will be planted from one another and the **planting arrangement** that will be used. We'll explain what these things mean in a minute.
- 3) Define what shape to give the adult cacao trees and what size they will be kept at by means of pruning.



What you're
saying seems very
important to me Filadelio,
and I think it would be
worthwhile to examine each
one of these decisions in
depth. Let's begin
with the selection
of the site.

Selection of the site where the cacao orchard will be planted

If there is one thing I've learned, it's that choosing the right site is super important for good productivity.


But what is it that makes a site good or bad for cacao?

I'll gladly answer your question, María.

The two most important factors that determine the quality of the site for the cacao crop are climate and soil conditions.

Cacao grows and produces well in fertile soils more than a meter deep with good drainage.

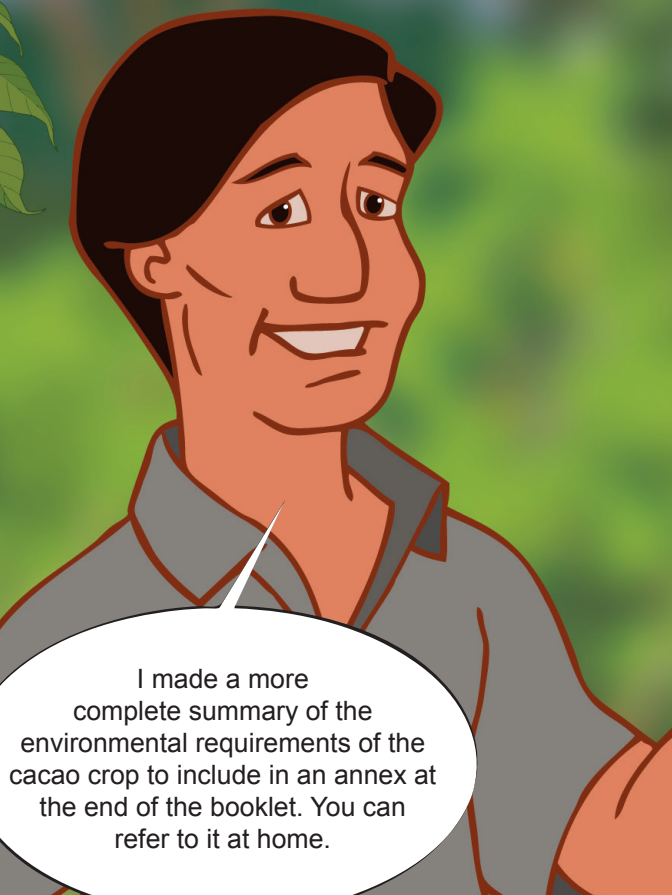
Cacao grows well in areas where it rains for seven or eight months of the year, rainfall exceeds 1400 millimeters, ideally 1800 millimeters, well distributed throughout the year and the air temperature never drops below 15 degrees Centigrade (equivalent to 59 degrees Fahrenheit).



Remember that the rain that falls on a place is measured in millimeters. A meter has one thousand millimeters.

When we say that a place has 1500 millimeters of rainfall,

equivalent to one meter and a half, this means that this would be the height of the water that falls in a year if it didn't filter into the ground, run off of the soil, or evaporate.

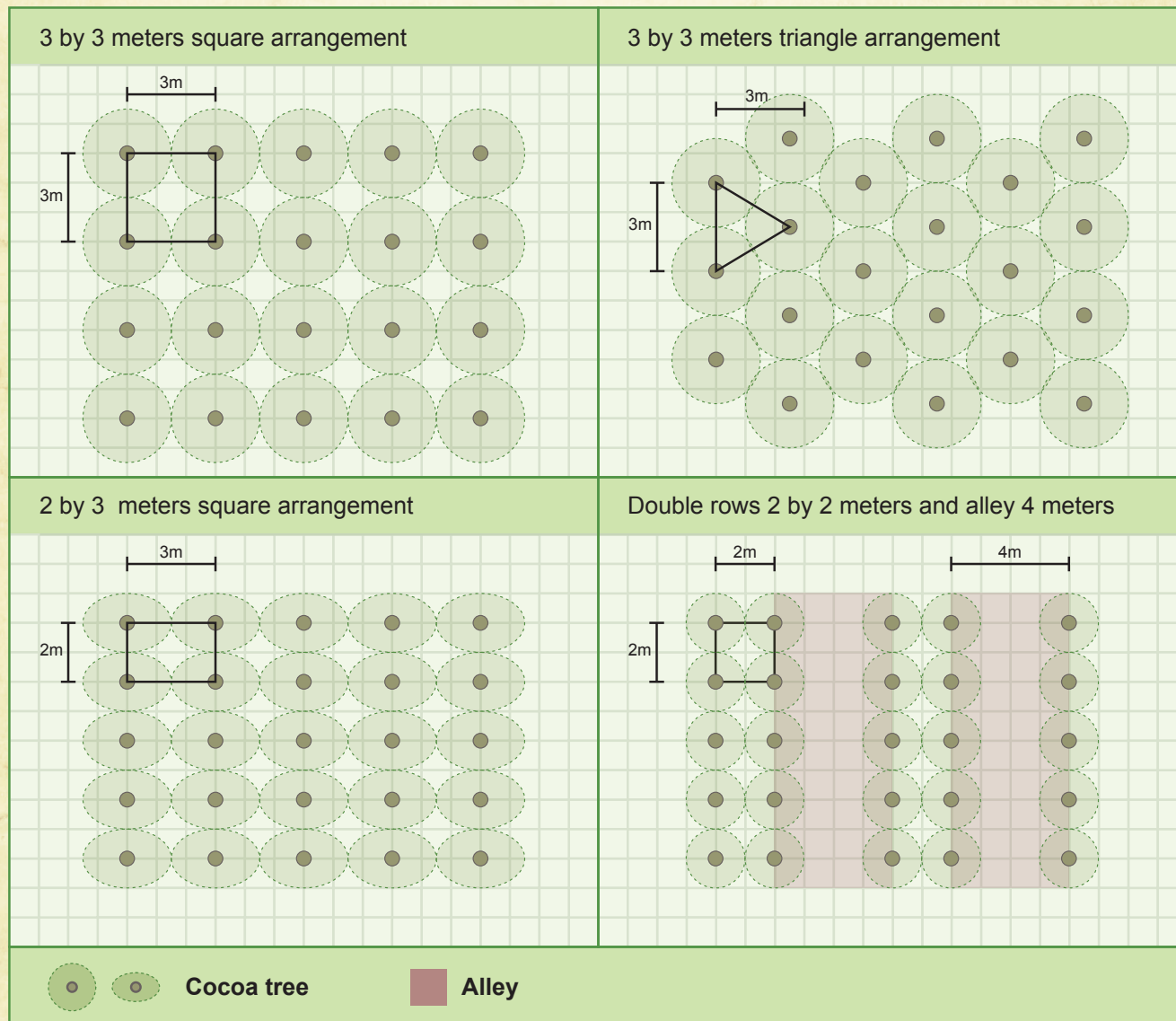


Thanks, Filadelio.

Once the plantation site has been chosen, the farmer must decide on the planting density and the planting arrangement to be used.



Planting density and plantation arrangement



Others common arrangement

| Planting distance | # plant/ha in square arrangement | # plant/ha in triangle arrangement |
|-------------------|----------------------------------|------------------------------------|
| 2 by 2 | 2500 | 2887 |
| 2,5 by 2,5 | 1600 | 1848 |
| 3 by 3 | 1111 | 1283 |
| 3,5 by 3,5 | 816 | 943 |
| 4 by 4 | 625 | 721 |
| 4,5 by 4,5 | 494 | 570 |
| 5 by 5 | 400 | 461 |
| 2 by 3 | 1667 | -- |
| 3 by 4 | 833 | -- |
| 4 by 5 | 500 | -- |

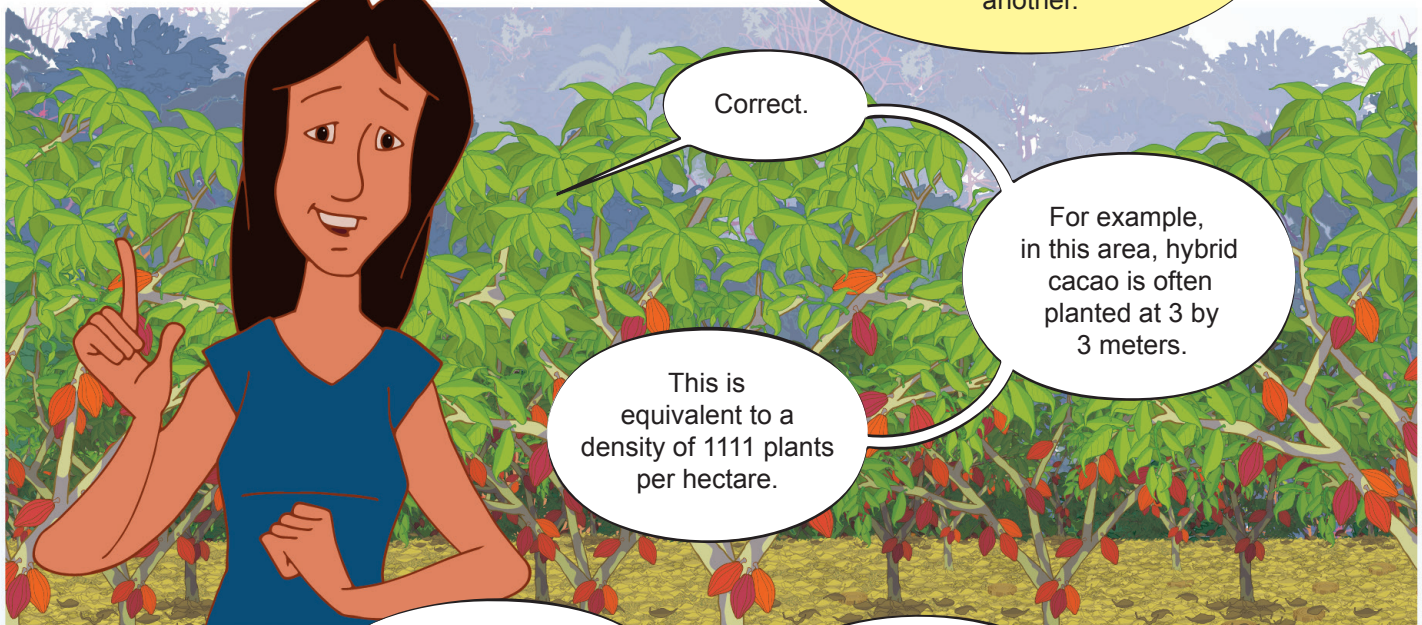


In case you didn't know,

planting density is the number of plants that are planted on one hectare of land.

Another way of indicating the density is to state the distance that the seedlings are planted from one another.

Understand?



Correct.

For example, in this area, hybrid cacao is often planted at 3 by 3 meters.

This is equivalent to a density of 1111 plants per hectare.



Some of us farmers plant cacao at high densities.

Look, in this plot the cacao was planted at 3 by 2 meters, or 1667 trees per hectare.

But the family sets the planting density depending on whether they want to produce only cacao or if they also want to grow fruit,

timber and other crops on the same plot. Isn't that right?



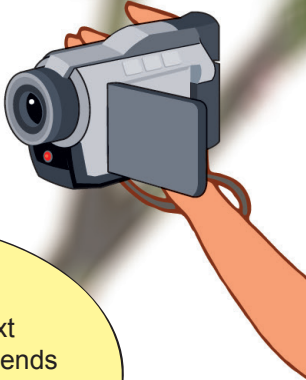
Indeed, Miriam.

For example, planting cacao at high density requires more labor and more fertilizer and it doesn't leave space for other crops. If in addition to producing cacao you want to produce fruit, timber and other products in the cacao orchard, you cannot plant cacao at high density.



I'm looking at the high density of ripe fruits on that guava tree.

I'm going to send a cell phone text message to my parrot friends to get over here quick, before the squirrels make off with everything.



You must also answer the questions:

What planting arrangement will you use to plant the cacao?

¿Will you plant them in a square, a triangle, in double rows?

Are we going to want to alternate a row of cacao with a row of plantain, like in Ismael and Zaida's cacao orchard?



Does anyone know at what densities they plant cacao elsewhere in the world?

It varies.

In some places, they plant it at low densities, in others at high densities. There are places where cacao is planted at low density, say, at 5 by 5 meters or 400 trees per hectare.

At this density, the cacao trees are not pruned much and they are large, but there is space for producing timber, fruits and other crops.



I'll continue.

Many cacao farms in my community are planted at 3 by 3 meters squares, which gives 1111 plants per hectare. This is a medium density and it also allows producing a little fruit, timber and other useful things.

Thanks, Gerardo.

High density cacao orchards are those that have more than 1300 trees per hectare.



These cacao orchards give high yields but they need intensive management with fertilizer, at high cost.

The size and shape of the cacao plant

Now we get to the third key decision:

What size and shape will the adult cacao plants have?

To really understand the answer to this question, we must review how the cacao plant grows.

First let's look at how a hybrid plant grows and then how a clone grows.

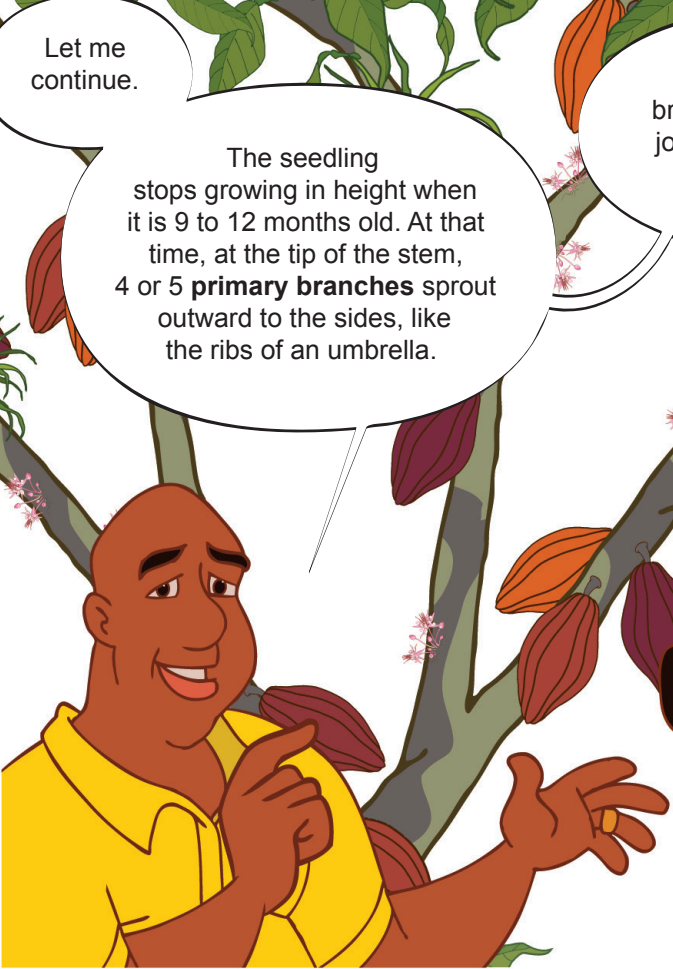
Okay.

We have all planted a cacao seed and seen how the seedling germinates and grows, passing through several stages until it becomes an adult tree. Gerardo, you like this topic,

why don't you explain it?


Thanks, Miriam.

After the seed germinates, the seedling begins to grow in height. As the stem grows, it produces leaves and gets taller and taller.




Let me continue.


The seedling stops growing in height when it is 9 to 12 months old. At that time, at the tip of the stem, 4 or 5 **primary branches** sprout outward to the sides, like the ribs of an umbrella.



This umbrella of branches is known as the jorquette and it looks like the one you see here.




Yes, but not all the plants produce the jorquette at the same time or at the same height. Some plants produce it earlier than others.



Some produce it at 10 to 12 months of age. Many produce it when they are 14 to 18 months old.

Some plants produce their first jorquette late, at two years of age.



I have seen plants that produce their first jorquette at very low height, less than one meter above the ground, while others produce it very high up, at more than 2 meters height.



Very good observation Cecilia.

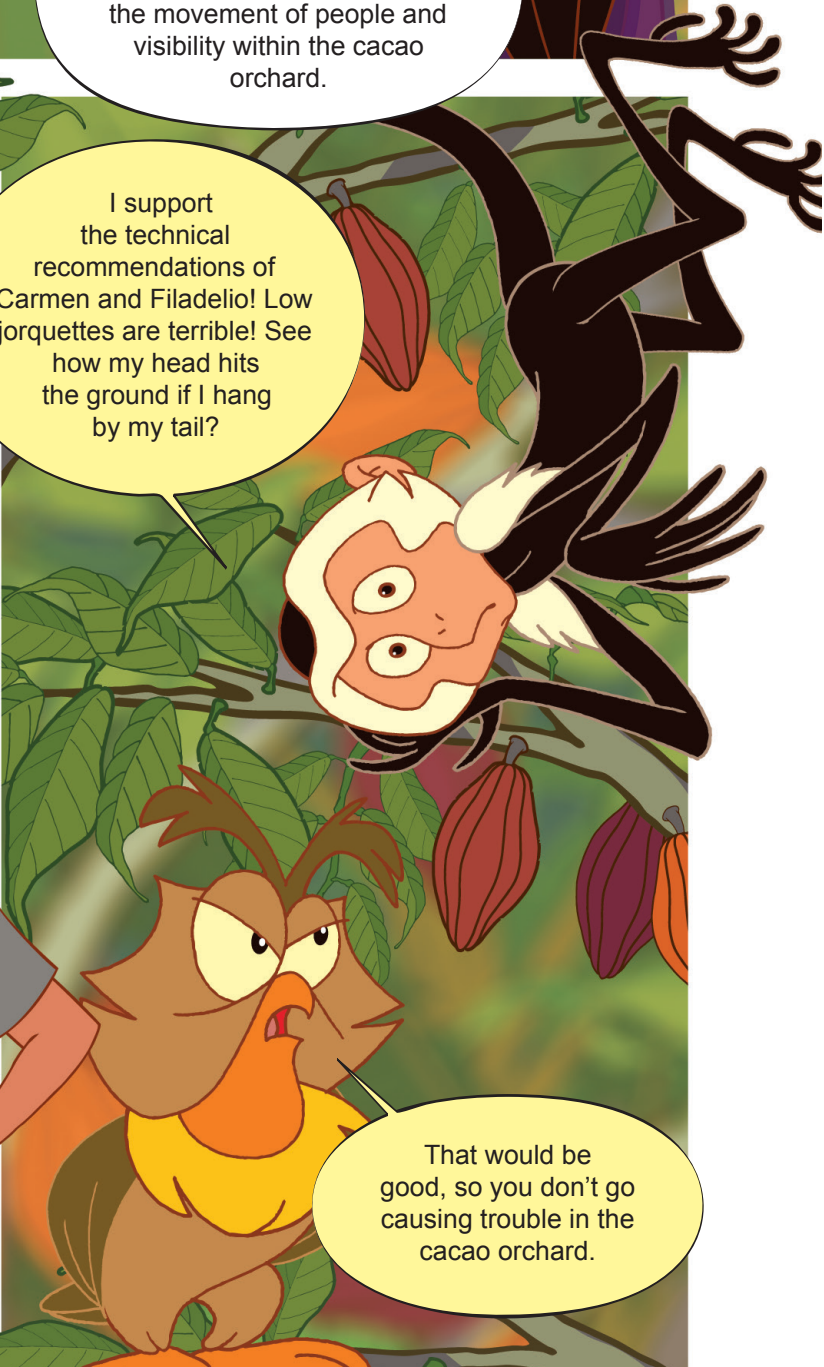
Ideally, the first jorquette would occur at one and one half meters above the ground. This would allow the movement of people and visibility within the cacao orchard.

I agree.

That height also facilitates pruning, the gathering of the harvest, and visibility and aeration are improved within the cacao orchard.

This can also reduce attacks by fungi and other pests and diseases that damage the cacao and its fruits.

I support the technical recommendations of Carmen and Filadelio! Low jorquettes are terrible! See how my head hits the ground if I hang by my tail?

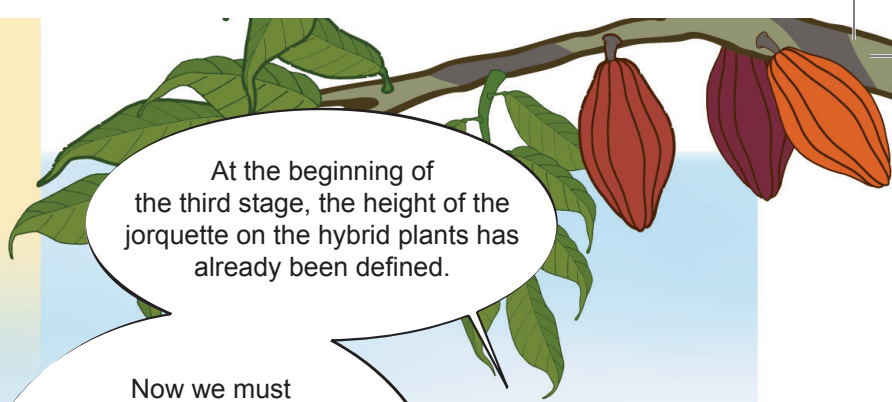


That would be good, so you don't go causing trouble in the cacao orchard.



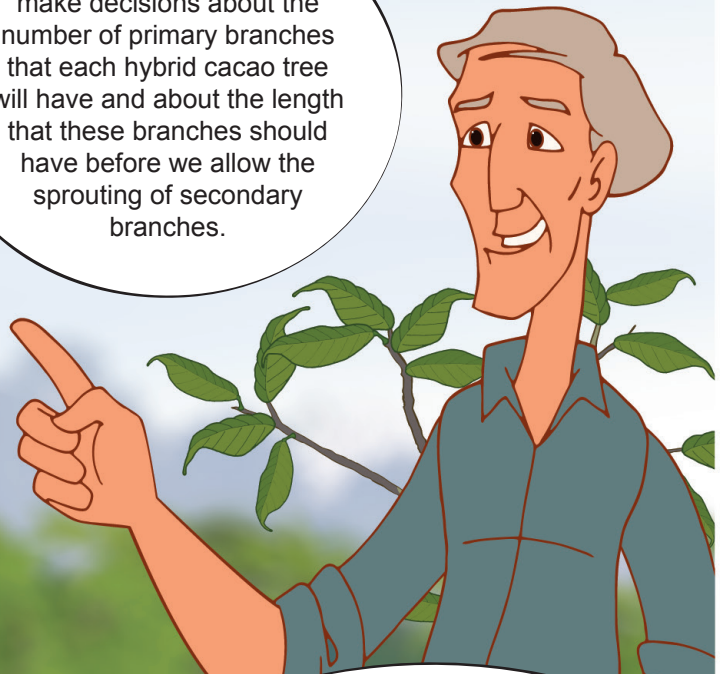


THIRD STAGE: Formation of the crown and beginning of production



At the beginning of the third stage, the height of the jorquette on the hybrid plants has already been defined.

Now we must make decisions about the number of primary branches that each hybrid cacao tree will have and about the length that these branches should have before we allow the sprouting of secondary branches.



First let's see how many primary branches per tree we will use.

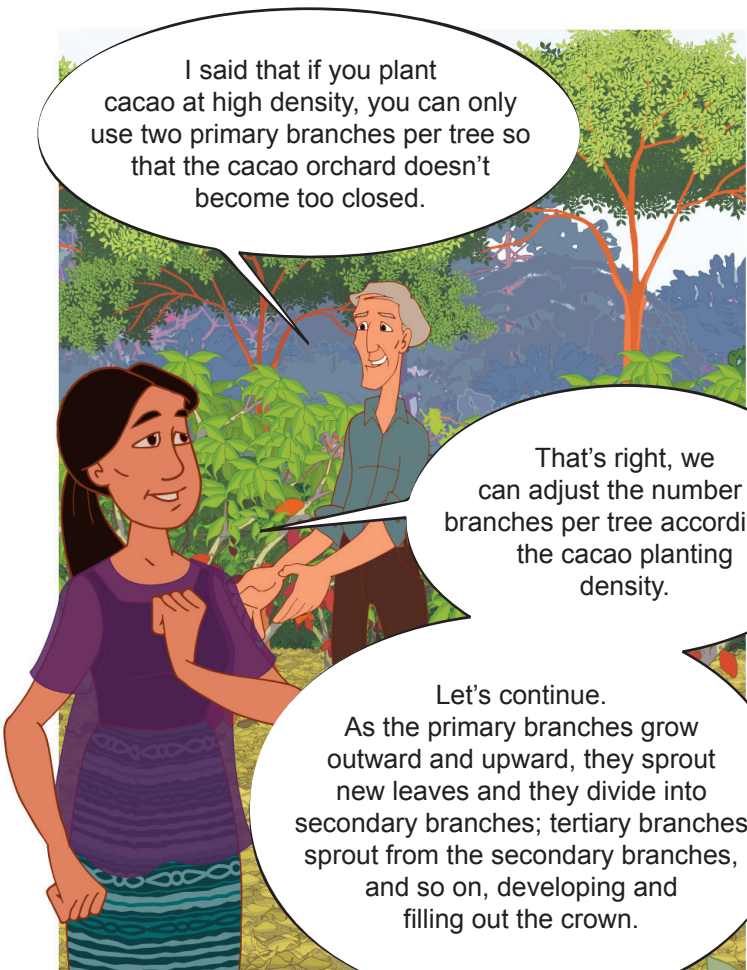
The tree naturally tends to sprout 4 to 5 primary branches from the jorquette.



At densities of 1111 plants per hectare, we producers usually choose 3 to 4 primary branches per tree, well distributed around the jorquette to produce a balanced crown.

What did you say, Alberto?

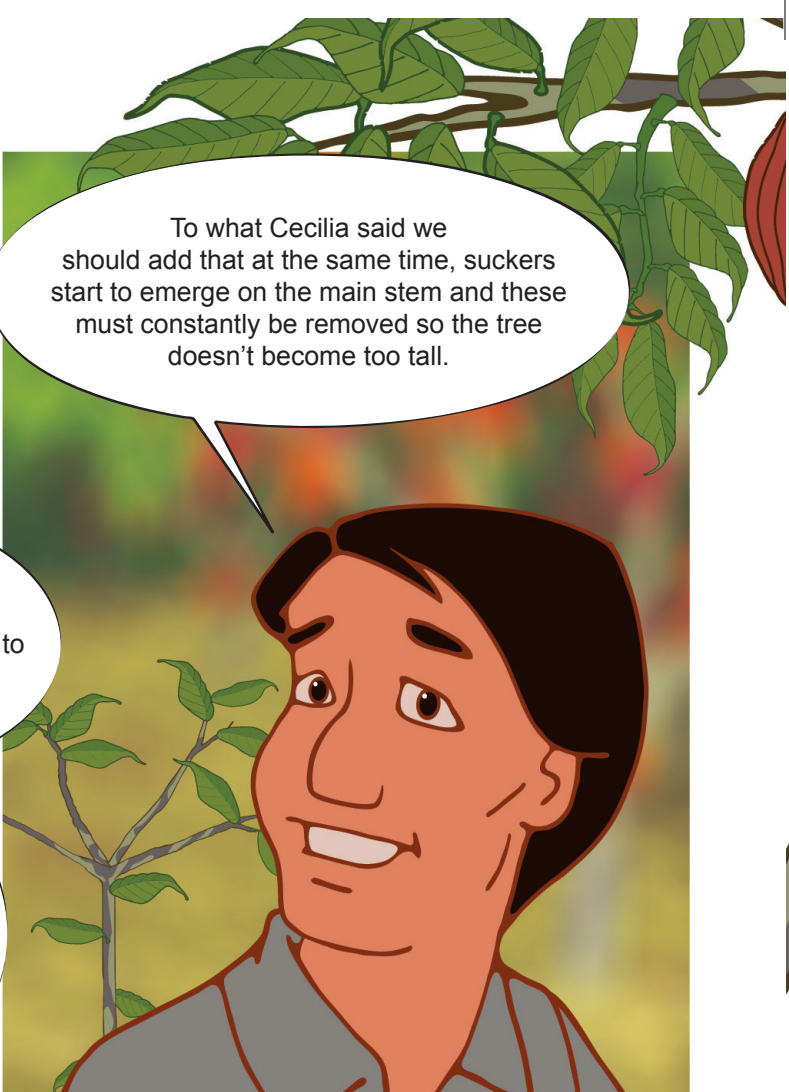





I said that if you plant cacao at high density, you can only use two primary branches per tree so that the cacao orchard doesn't become too closed.

That's right, we can adjust the number of branches per tree according to the cacao planting density.

Let's continue. As the primary branches grow outward and upward, they sprout new leaves and they divide into secondary branches; tertiary branches sprout from the secondary branches, and so on, developing and filling out the crown.



To what Cecilia said we should add that at the same time, suckers start to emerge on the main stem and these must constantly be removed so the tree doesn't become too tall.




Many cacao agronomists recommend pruning all secondary branches that sprout in the first 75 centimeters from the primary branch, measured from the jorquette.

Do you know why?

I can tell you: because this helps keep the center of the crown open and it concentrates most of the flowers and fruits that the cacao tree produces on the trunk and on the first 75 centimeters of the primary branches.




Long live the monkey!




I object to this shape for the cacao plant. I propose that fruit production be stimulated on the highest parts of the branches. That way I don't have to go down to the ground to eat the fruits.


I don't want to get too tired!



Fortunately, we're not going to pay any attention to those two. If the pods are high up on the branches, we can't pick them, they get attacked by diseases and the whole plantation becomes contaminated.




We have now explained how you shape a hybrid tree to an ideal height of 3 to 4 meters. Let's see now how to shape a clone.



This depends on the kind of clone we are working with. For example, in the first stages of the life cycle, grafts, rooted cuttings or air layers are managed differently.

And we don't manage a graft produced in the nursery like a scion graft on a sucker in the field.

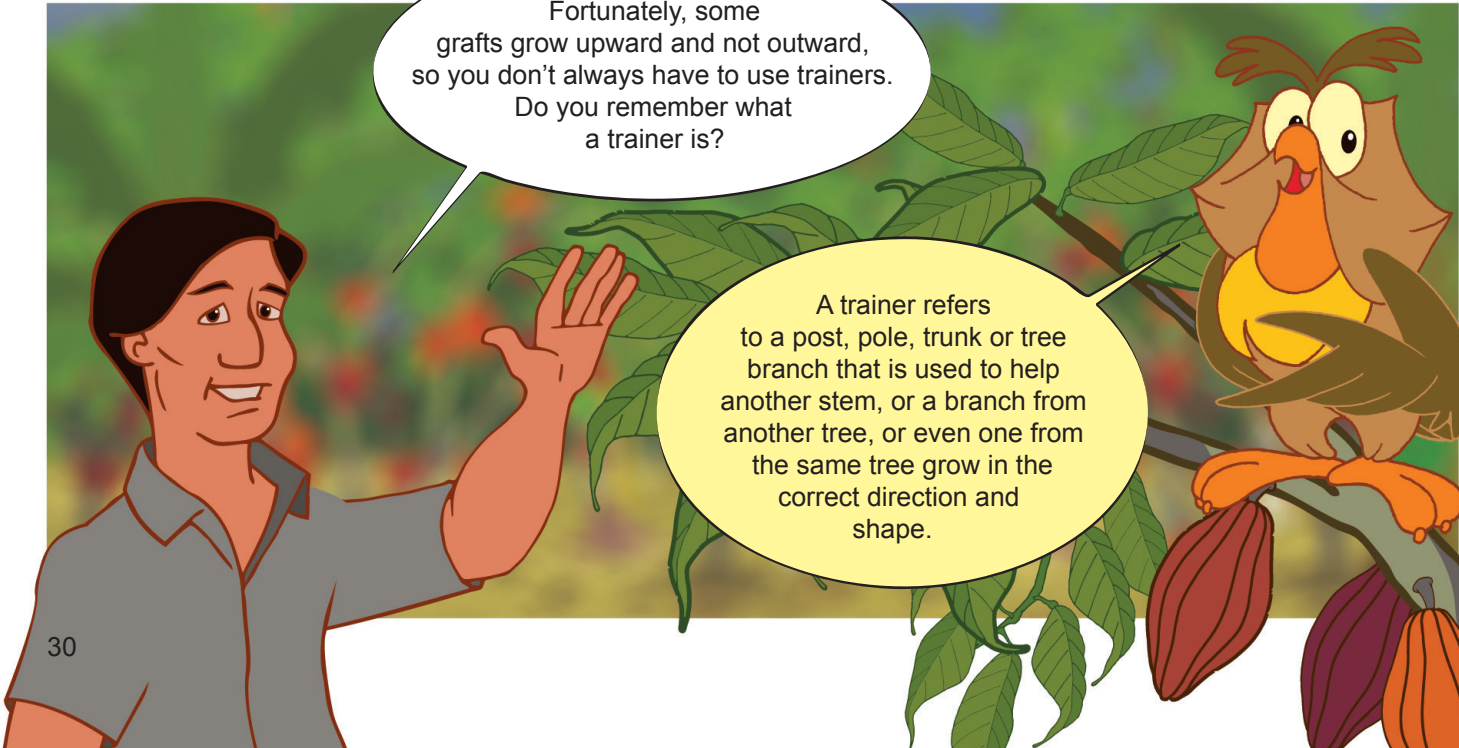


That's right. With grafts you have to watch out for two things.

First, buds or scions grafted onto the side of the rootstock tend to grow outward rather than upward, so trainers must be used to direct clone's growth upward.

Secondly, the rootstock tends to sprout very vigorous suckers.

Folks, I think that cuttings and **air layers** require less care because they are planted upright in bags, ensuring they will grow upward. Also, cuttings and air layers sprout few suckers.



Fortunately, some grafts grow upward and not outward, so you don't always have to use trainers. Do you remember what a trainer is?

A trainer refers to a post, pole, trunk or tree branch that is used to help another stem, or a branch from another tree, or even one from the same tree grow in the correct direction and shape.



What a memory!

smarty-pants!

I am going to continue with the formation of the crown for clones.

Once the growth of the main axis of the clone has been directed upward to form the trunk, the steps for the formation of the crown are very similar to those for the hybrid tree. At this point it doesn't matter whether the clone came from a graft, a rooted cutting or an air layer.

I get it. With either a clone or a hybrid plant, we control the height where the primary branches sprout, right?

That's right.

So that the primary branches sprout at a certain height, let's say a meter and a half high, we wait until the graft, cutting or air layer has reached that height and then boom! We cut the tip off the main axis.

This activates the buds near the site of the cut and makes the primary branches sprout.

And if the primary branches sprout before the main axis reaches the height we want?

Easy

clip
clip

We cut off all the shoots that emerge before the main axis reaches the desired height.

When they finally reach the height we want, then boom! We tip them again.

Boom,
boom!


Stand still and put your hands up, I'm going to tip you!

We shape the rest of the crown like we do for hybrid plants.

We let each primary branch grow to the length we want without secondary branches, and then we tip them so that the secondary branches sprout.


The idea is simple, don't you think?

Parrot, we aren't here to play cowboys. Careful you don't put my eye out with those scissors. Calm down.




To sum up: We can say, for both hybrids and clones, the shape and size of the cacao plant can be adjusted by controlling five things:

1. The number of trunks or primary axes. Usually one trunk per planting site.
2. The height at which the trunk or main axis forms the jorquette.
3. The number of primary branches that we are going to leave on the jorquette.
4. The length of the primary branch without secondary branches, measured from the jorquette.
5. The total height of the tree.



The way that these decisions are made is what gives rise to the variety of sizes and shapes of the cacao plants that we find when we visit different cacao farms.



Indeed; for example, my neighbor Mayra has clones with a single short trunk, barely half a meter in height, two primary branches with no secondary branching under a meter and a half, and a crown that is not more than three meters high.

Very good, look here.

Between 4 and 10 years of age, the number of secondary and tertiary branches will increase; they will grow and get longer, increasing the size of the crown until they reach the maximum height desired and fill the vital space of each cacao tree in the orchard.



Vital space is the area that each tree needs to grow and produce well in the cacao orchard. Vital space includes:


1) The area of land as defined by the arrangement and the planting distances. For example, if the cacao is spaced at 3 by 3 meters, each tree gets 9 square meters.

2) The subsoil for the tree.

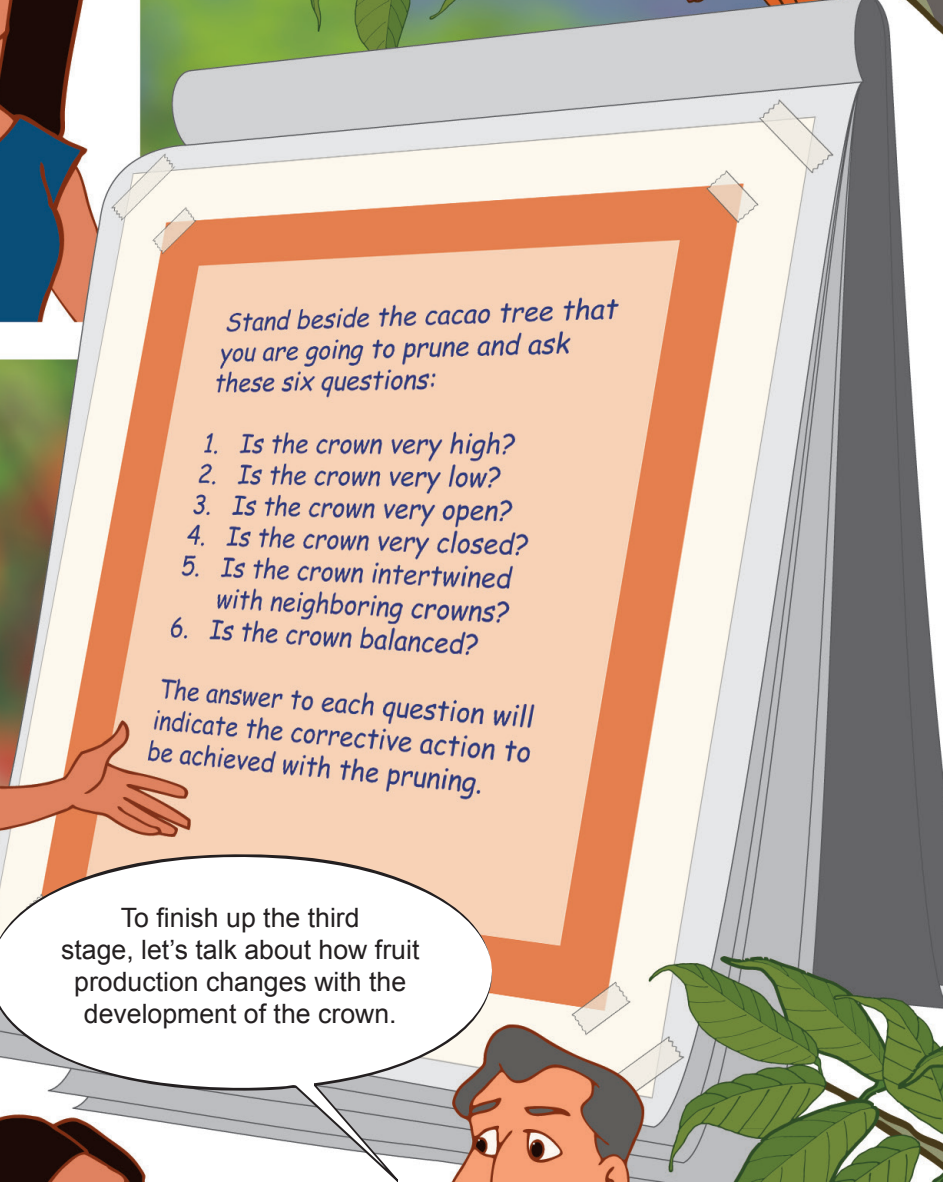
3) The air, light and everything above the tree.

Cocoa trees must be pruned regularly so that they don't invade the vital space of their neighbors.






I've brought you a poster with the 6 steps to follow to prune a cacao tree. Let's take a look.



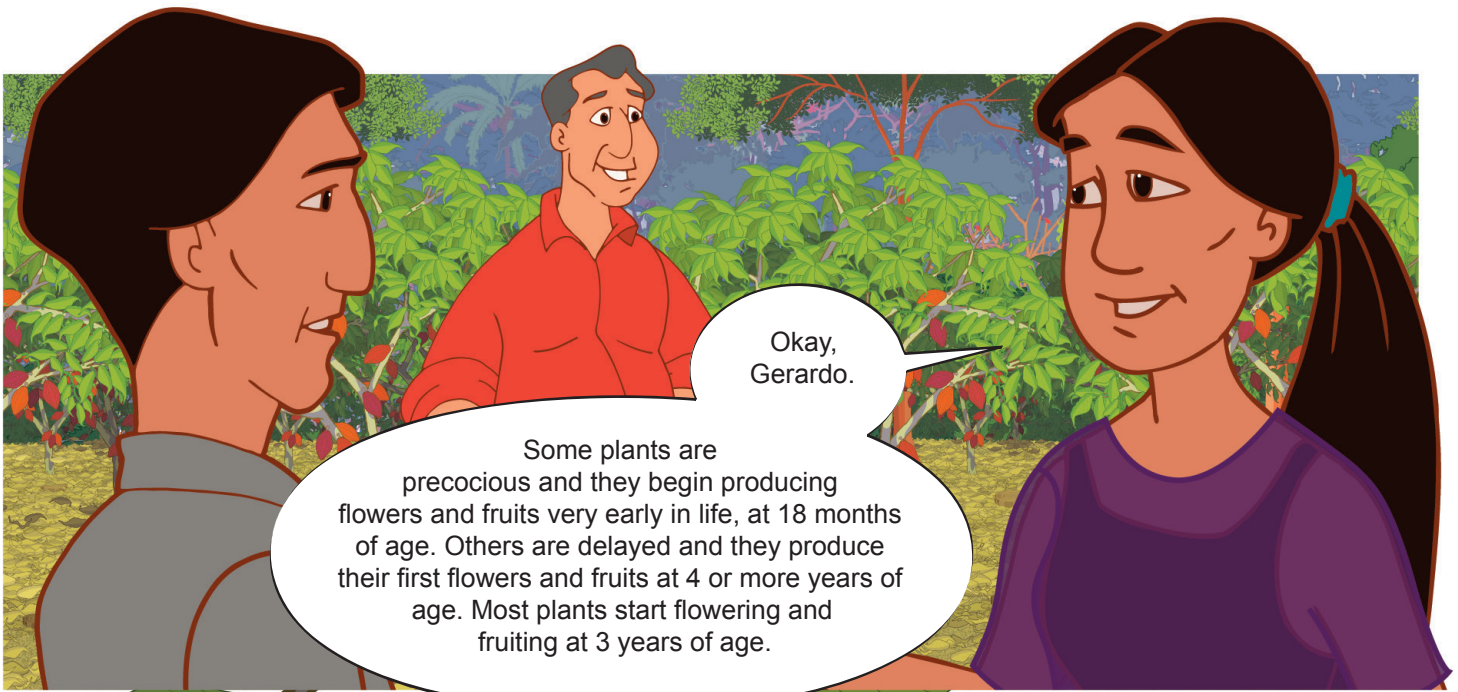
Stand beside the cacao tree that you are going to prune and ask these six questions:

1. Is the crown very high?
2. Is the crown very low?
3. Is the crown very open?
4. Is the crown very closed?
5. Is the crown intertwined with neighboring crowns?
6. Is the crown balanced?

The answer to each question will indicate the corrective action to be achieved with the pruning.



To finish up the third stage, let's talk about how fruit production changes with the development of the crown.



Okay, Gerardo.

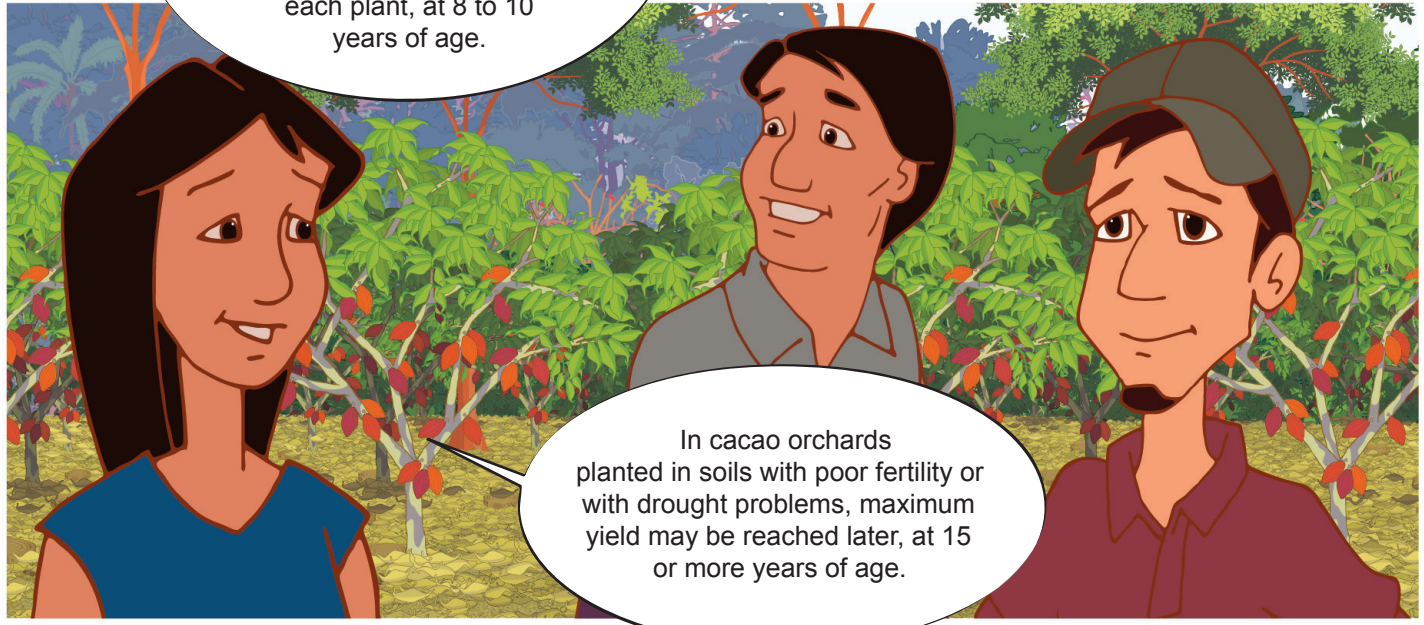
Some plants are precocious and they begin producing flowers and fruits very early in life, at 18 months of age. Others are delayed and they produce their first flowers and fruits at 4 or more years of age. Most plants start flowering and fruiting at 3 years of age.



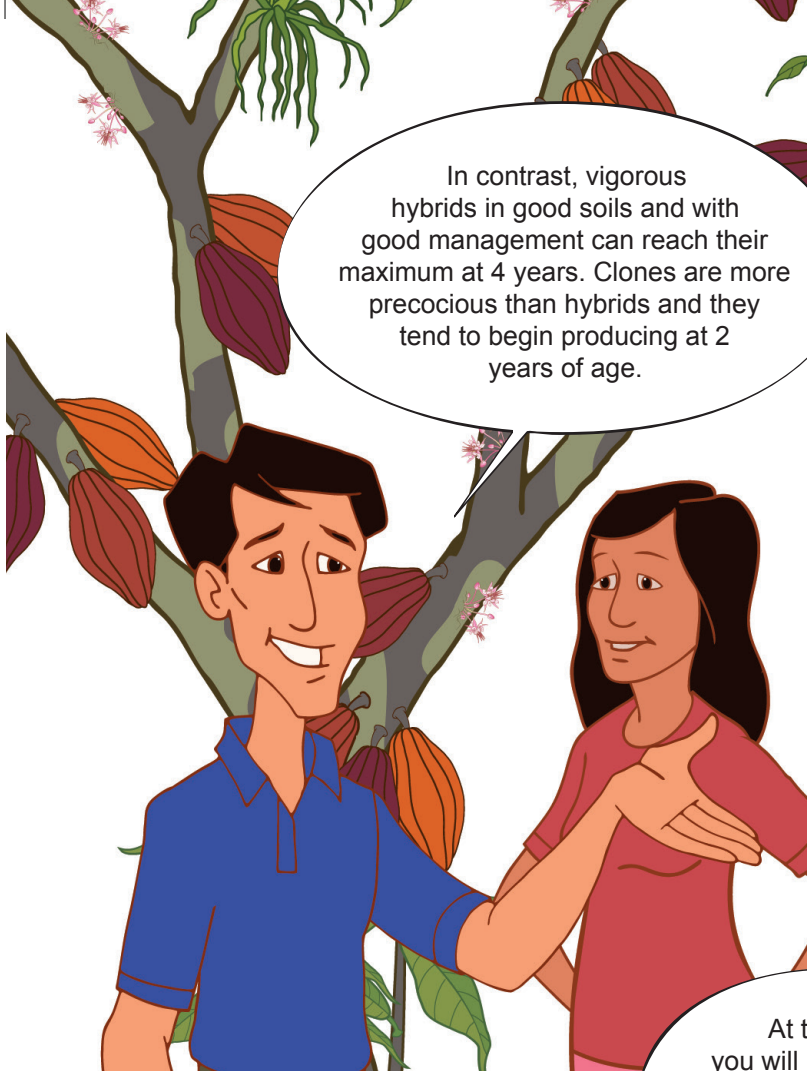
The crop increases with the age of the cacao plant at this stage.

The first flowering is weak and few flowers and fruits develop.

The next year, the second flowering will be larger. Another year later, the third flowering will be larger than the second and so on successively until reaching the maximum, characteristic for each plant, at 8 to 10 years of age.



In cacao orchards planted in soils with poor fertility or with drought problems, maximum yield may be reached later, at 15 or more years of age.



In contrast, vigorous hybrids in good soils and with good management can reach their maximum at 4 years. Clones are more precocious than hybrids and they tend to begin producing at 2 years of age.




Right.

At the end of the third stage, around 10 years of age


the cacao trees have the adult shape and size and they all fully occupy their vital spaces.

At this age, you will have seen at least five years of harvests and the annual production of each tree will have already stabilized.




Very good. Now the fourth stage of the cacao life cycle begins.

FOURTH STAGE OF THE CACAO LIFE CYCLE: Full production (years 11 to 30)



In this stage, the size and shape of the cacao plant is managed by considering the six questions for pruning that we used in the prior stage.




Annual cacao production will have its ups and downs. Some years the cacao will have a good harvest and other years it won't.




Right.

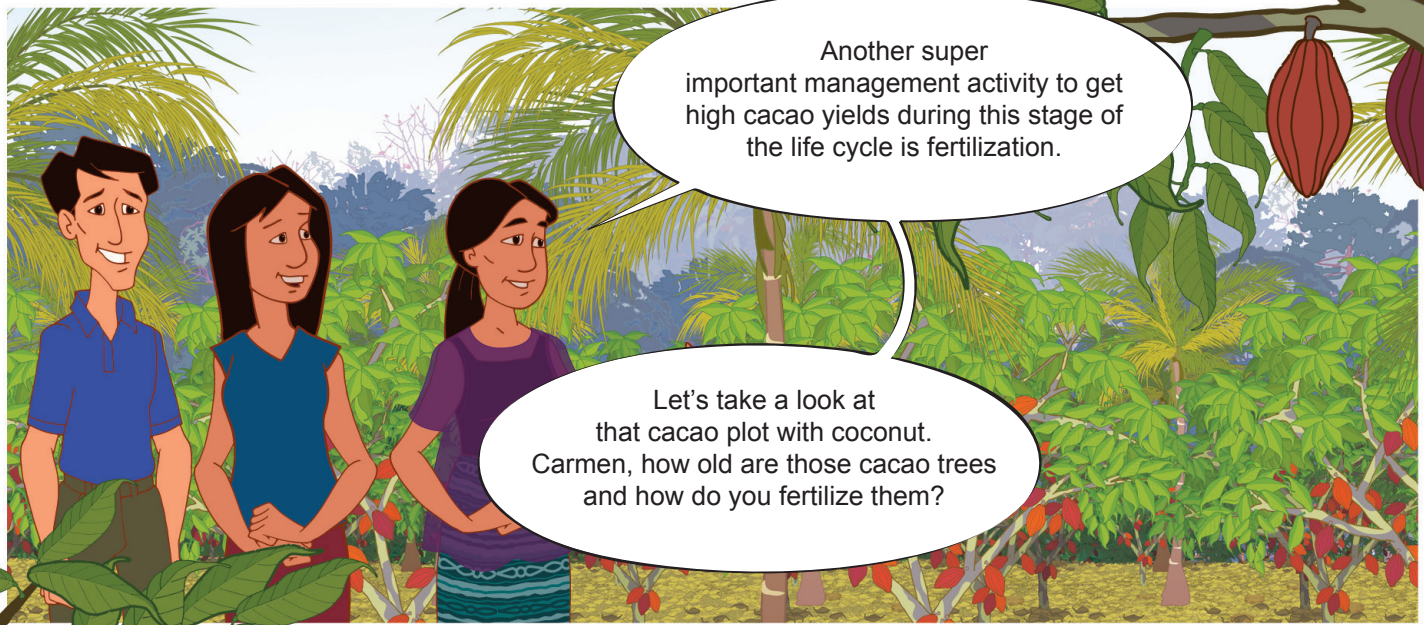
Weather has a lot to do with this. Sometimes it rains too much during flowering; this affects pollination and reduces the crop. Other times the weather is perfect during flowering and the crop is good.



Yeah Carmen, this year the weather was great. You should have seen the crop we had!



Tell me about it! I gained more than 5 pounds, ha ha!



Another super important management activity to get high cacao yields during this stage of the life cycle is fertilization.

Let's take a look at that cacao plot with coconut. Carmen, how old are those cacao trees and how do you fertilize them?



That plot has hybrid cacao planted by my father-in-law 18 years ago, with coconut for shade.

We use 3 kilos of organic fertilizer per cocoa tree and we apply it in a one meter circle around the trunk, where the roots are more active and "suck it up" better.



This plot looks very well tended. I don't see any diseased fruits on the cacao trees, nor any of the fruits they call **mummies**.

We always eliminate the mummies and the diseased fruits so that the other trees don't get sick.

Aaaaah!

All this talk about mummies is making feathers stand on end and I get goose bumps...I mean, it gives me chills.

Some cacao trees die during this stage due to natural causes, attacks by pests or damage caused by falling shade trees or branches.

You have to continually be replacing any plants that die or are damaged. If you don't maintain the planting density of the cacao orchard, production will fall.

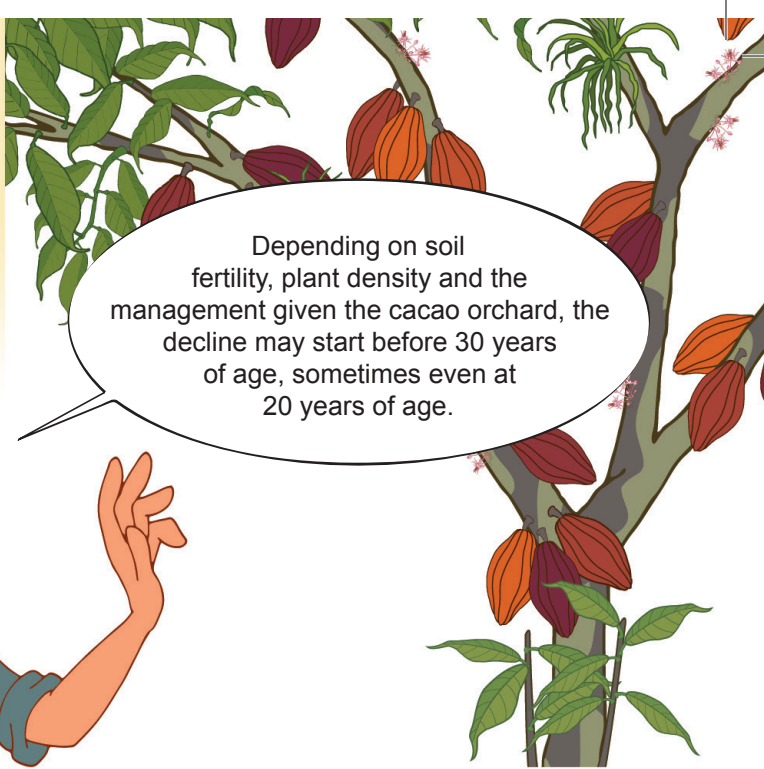
Shade management is another important activity in this stage of life. Time must be invested in the management of crops like bananas, plantains or **peach palms**. We should do the same with the fruit or timber trees that are planted with the cacao.

In these discussions you should always bear in mind that part of the banana and fruit crop is for the food security of my family.

If you touch them, I'll complain to the animal welfare society!

Is anyone paying attention to the monkey? I think not. Let's continue. At 30 years of age, the cacao plant enters its fifth stage of life, the stage of declining production.

FIFTH STAGE OF THE CACAO LIFE CYCLE: Declining production (years 31 to 60)



Depending on soil fertility, plant density and the management given the cacao orchard, the decline may start before 30 years of age, sometimes even at 20 years of age.



That's right


Flory, what did you do when your cacao farms started to decline?



Come over here and see this 35-year-old plot that has declined a lot and isn't producing much.

We realized that some new, very good cacao clones are now

available and we decided to renovate the entire plot and plant it with these new clones.



The clones produce high yields, they aren't attacked by diseases as much, they have large seeds and they produce a chocolate of high quality.

Then, two years ago, we eliminated all the hybrid cacao trees in every other row.

And in each row that we left, we eliminated every other tree.


Okay, I understand. This way you used the old hybrid cacao trees as temporary shade for the clones that you planted in the empty spaces.

Exactly, and once the clones reach a certain size, then we'll take out the rest of the old cacao trees.


Right, before thinning out the hybrid cacao and planting the clones, we cut down the large timber trees that could be milled, used or sold, so as not to damage the new cacao.

Then we planted the new trees in places where there hadn't been any shade.


What type of planting material was used?



Three quarters were bud-grafts that we obtained in a nursery and the other quarter were top grafts on suckers using scions taken from the five most productive trees on the farm.



Now every 2 to 3 months we cut the suckers off the rootstocks and remove, low, hanging branches.



In this stage of the life cycle, you must constantly face three alternatives:

- 1) Rehabilitate the cacao orchard.
- 2) Renovate the cacao orchard completely, which consists of replacing the unproductive cacao plants with new plants in the same site.
- 3) Plant a new cacao orchard in another site.



Rehabilitation consists of restoring vitality to a cacao orchard that is still capable of responding to good management.

We will leave the details of each one of these three alternatives for another meeting in the near future, since the topic is quite extensive

Do you agree?



Agreed, Cecilia. We are rehabilitating our 40-year-old hybrid cacao orchard. We topped the crowns of half of the trees and reshaped them. These trees are now in very good shape.

At the end of the fifth stage, the cacao plant is ready to enter into the final stage of the life cycle: old age and death.




I like this talk about getting into good shape.

How about this powerful pose?


I'm in really good shape!




SIXTH STAGE OF THE CACAO LIFE CYCLE: Old age and death (61 to more than 100 years of age)




I don't think that any cacao producing family should let their cacao orchard reach this stage, where cacao production is no longer important.




You're right, Alberto. At this stage of the life cycle, you have to answer several important questions, for example, when to put a stop to the life cycle of the cacao orchard and how is this done?




Other important questions at this stage are:



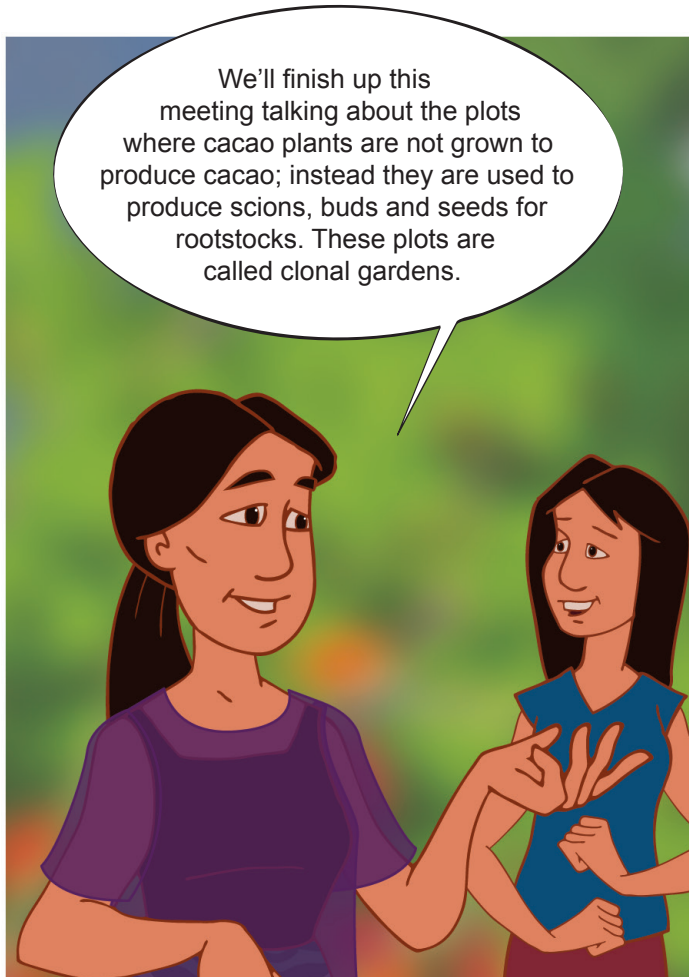
Should we plant cacao again in this same site or should we do it in another site?




Do we leave some of the existing shade plants or should we also eliminate the shade when we eliminate the old cacao?



This stage ends with the death of the cacao orchard and the preparation of the land for a new crop cycle.





But you can also manage a plot for dual purposes: producing cocoa beans and producing scions, buds and seeds for rootstocks. My neighbor does this.

Hear that, Mr. Monkey. It would do you good to become a dual purpose monkey: Next year you can try to be less gluttonous and more hard-working.

Wrong

My two goals for next year are to taste the new cacao clones and to sleep more hours per day.

Very well. Now we have covered all the topics we meant to look at today.

And just in time, it looks like it's going to rain. What do you say we end the meeting?

To drink hot chocolate back at the house. Until next time.

Motion approved. Like we always say: Running, running, quick as a mouse.

ANNEX 1. Environmental conditions where cacao grows

Rainfall

- Optimum range from 1500 to 2500 millimeters of rainfall per year (with no more than 3 or 4 dry months)
- In very rainy areas fungal diseases are more common
- In areas with strong drought (more than 4 dry months), tree growth is retarded, fewer leaves are produced, the leaves fall off and fewer fruits are produced. In dry areas insects are major pests.

Temperature

- Optimum range is an annual average of 23 to 25 degrees Celsius
- Below 21 degrees Celsius growth is

reduced, there are few shoots and almost no flowering, fruit development and ripening is slower

- Low temperatures also favor diseases such as black pod.

Wind (more than 14 kilometers per hour):

- Increases the excessive loss of water and causes premature leaf fall. Cacao is very sensitive to wind.

Altitude

- From sea level to 1200 meters of altitude, depending on the latitude of the site. Can grow at higher

elevations that are closer to the Earth's equator.

Soil

- Depth (1.0 to 1.5 meter).
- Medium textures: loamy, muddy loam, loamy clay.
- Groundwater level (below 1.5 meter).
- Rock content (the soil should not have large rocks).
- Slope: 40 percent maximum (40 percent means that for every 10 meters of distance the ground rises 4 meters).

GLOSSARY

Air layers or air layering

Technique that consists of ringing and wrapping a part of a branch so that it sprouts roots while it is still on the tree. The branch is then cut and planted in a bag in the nursery to develop a new cacao seedling.

Bud

The buds are the growth organs of the tree. The leaves and branches sprout from the buds. Buds are little enlargements on the branch, found in the axils of the leaves.

Cacao orchard

A cacao orchard is a plot where cacao has been planted, as a single crop or with other plants and trees.

Spanish cedar (*Cedrela odorata*)

Timber tree that produces wood of excellent quality.

Clone

Trees obtained by grafting, rooted cuttings or twigs in a bag, or by means of another asexual propagation technique are clones. They are genetically identical to the parent plants from which they were obtained.

Hybrid

Hybrids are plants resulting from seeds that are produced when parents (male and female) of different species, varieties or clones are crossed. For example, Trinitario cacao is a hybrid resulting from the crossing of the Criollo variety of cacao with the Forastero variety. Another example: a hybrid can also be produced by sexually crossing one clone with a different clone.

Peach palm (*Bactris gasipaes*)

Palm that produces fruits that can be eaten by humans and animals. Also known as pivá or pejobaye.

Permanent shade

This is the shade given by trees that were planted to provide shade to the cacao crop for many years.

Pigeon Pea (*Cajanus cajan*)

Also known as gandule bean or frijol de palo.

Plantation arrangement or planting arrangement

This is the way the cacao and shade plants are arranged in the plot. Some of the most commonly used plantation arrangements are: square or triangular.

Planting density of a crop

This is the number of crop plants in a unit of area, usually a hectare. For regular planting arrangements, the planting density can be given by indicating the distance between the crop plants.

Primary branches

These are the branches that sprout from the jorquette in the main trunk.

Rootstock

In a graft, the rootstock is the tree that receives the graft.

Scion

A scion is a piece of a twig that contains several buds.

Sucker

The suckers of the cacao tree are differentiated from the branches in the way their leaves are arranged and because their growth is upward, whereas branches tend to grow out to the sides.

Temporary shade

This is a rapidly growing crop that is used to shade the young cacao plants until the permanent shade trees reach sufficient size to shade the cacao trees.