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Fruit growing in the tropics

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Agrodok 5

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Foreword

The previous editions of this Agrodok, published in 1992 and 1999, gave a general introduction into fruit growing in the tropics and described 8 major crops. Working on this revision, the general introduction quickly filled the entire Agrodok! And if the major fruit crops are to be dealt with anew, each crop will no doubt require an Agrodok of its own. In fact it may be better to publish regional crop manuals, rather than trying to cram information for various parts of the tropics into a single booklet.

The aim of this revised text is to foster your interest in and understanding of fruit growing. Traditional knowledge has been combined with insights gained through research work. No recipes are given for growing specific fruit crops. The contents are directed at home gardeners, growers who depend for (part of) their income on the sale of fruit, extension workers and others who support gardeners and growers.

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Wageningen, August 2006
Ed Verheij

Contents

1 Introduction

1.1 No flowers, no fruit

So you are interested in growing fruit! Perhaps you already grow fruit in a home garden or in an orchard, or you intend to do so. This Agrodok is written to make you feel at home amidst the different fruits crops you see around you. More than 60 fruits are mentioned in the text. The Index at the end lists the botanical names and the pages on which you can find more information about these fruits. There is also an Appendix with particulars about the flowers (in connection with pollination), the fruit, the seed and the common methods of propagation.

No flowers, no fruits! Scanty flowering is the main reason for disappointing crops in the tropics. Hence the flowering habit of a fruit crop is extremely important. Flowering habit is linked with tree habit, as explained in Chapter 3. A few very common fruit crops – pineapple, banana, papaya, (also palms) – have the growth habit of a single large shoot. These fruits as a rule flower and fruit well if they grow well. So they respond to the common measures to stimulate growth – watering, manuring, crop protection – that every farmer knows about. But the large majority of the fruit crops branch freely issuing hundreds or thousands of shoots. Each of these trees branches in its own typical way. These freely branching trees get the most attention in this Agrodok, because they are the problem crops that often flower poorly.

The main reason for scanty flowering is simple: the tree ‘forgets’ to form floral buds because it is too busy making new shoots. In fact most branched fruit crops require a period of stress – in the form of a cold or dry season – to put a stop to shoot growth in favour of laying down floral buds. And if the natural stress is inadequate – as is the case in large parts of the tropics for many fruit crops in most years, you will need to check shoot growth yourself. In such tree crops, therefore, measures to limit shoot growth and measures to stimulate growth should be alternated according to the seasons. Thus the grower

of these fruits needs special skills and has to apply them at the right time. The aim is to achieve a better *BALANCE* between vegetative growth and reproductive growth (the course of events from the initiation of floral buds to ripening of the fruit). This is the subject of Chapter 6.

Pruning, discussed in Chapter 5, is one of the skills employed in branching trees. But in the tropics the results of pruning are all too often negative. The main reason is that pruning leads to compensatory regrowth, which sets back the formation of floral buds. Thus pruning is important mainly when trees flower and fruit abundantly, so that shoot growth needs to be stimulated rather than flowering,

Without flowers no fruit. But also: without pollination no fruit set! There are exceptions to this rule, but flowers generally need to be pollinated, preferably by cross-pollination, to set fruit. Fruit crops differ greatly in the types of flowers they bear and in the way pollination and fruit set is effected. This important subject is dealt with in Chapter 7.

1.2 Importance of trees and fruits

Big trees and small trees

Trees are the natural vegetation in large parts of the tropics, in particular, in humid regions. The importance of trees stems partly from their large size and perennial character. Trees shape the landscape and frame buildings; they cast their shade over man and beast. They protect the soil against the hot sun, heavy rain and strong winds, especially during seasons when there are no annual crops in the fields. The roots explore deep soil layers, recycling water and nutrients that cannot be reached by the roots of field crops. In these ways, trees ameliorate their immediate environment.

There is increasing evidence that trees protect and exploit the environment more effectively than annuals. Evergreen trees have the advantage over seasonal crop plants in that the canopy of leaves is present throughout the year. Agrodok 16: Agroforestry, explains the role

of trees in more detail, both in the environment and in the farming system.

As a fruit grower you harvest fruit, not leaves and wood. Unfortunately, the so-called 'harvest index' – that is the share of fruit in the total amount of organic matter produced – is often quite low, especially for most freely branching fruit trees. The tomatoes, eggplants, cucurbits, etc. of the vegetable grower may not exploit the environment nearly as well as the tree fruits, but they yield many more tons of fruit per ha than most trees. Perhaps you should grow vegetables...

People think it natural that trees grow to a large size, but in fact trees grow big because poor flowering and fruiting leave enough energy for ever more shoots to grow. As a fruit grower your aim should be to produce fruit with a minimum of wood! If you could make a tree bear a full crop – in relation to its size – each year, starting within a few years from planting, it would never grow big. Imagine a mature mango tree the size of a coffee bush: think of the ease of pruning, crop protection, selective harvesting... For the fruit grower *SMALL IS BEAUTIFUL*. This is the conclusion of Chapter 2, in which the different cropping systems for fruit are compared.

Cloning is the first step towards control over tree size, as explained in Chapter 4: Propagation. In Chapter 9, Harvesting, it is argued that large tree size and top quality fruit do not go together: harvesting each fruit when it is at its best is impossible and avoiding blemishes is difficult.

Who eats fruit and why?

In Africa fruit is often considered as 'food for the birds' (Swahili:"chakula cha ndege") and it is left to children to compete with the birds; a man – it is said – should drink beer. In Central and South America, people are usually more fruitminded. Asians generally have a great appreciation of fruits.

The regard for fruit appears to be related to the propagation methods. Until recently fruit trees in Africa were commonly raised from seed; hence there were no named varieties or cultivars (banana being an important exception). Asia, on the other hand, is the area of origin of several important cloning methods, enabling growers to propagate superior varieties. Appreciation of the distinct taste of each variety developed through the ages. Home gardens flourish, people are familiar with home preservation and cooking methods, and aware of the health benefits traditionally attributed to each fruit. But for all that most people in Asia must make do with far less fruit than they would like to eat.

1.3 Reasons NOT to grow fruit

This booklet is meant to put across new ideas to gardeners, growers and extension workers. The intention, of course, is to encourage you to grow fruit. Nevertheless it is only fair to briefly list reasons not to grow fruit as well, even though you have probably thought of these reasons yourself.

No doubt you took into account that it takes years before you can harvest the first crop. And when the trees come into bearing they may fail to flower, or to set fruit, or that the fruit may drop prematurely. But, supposing the trees are doing fine: have you considered the risk of fire scorching your trees? And what about pilferage, birds, bats and rats eating the fruit, not to say anything about losses due to other pests and diseases?

The fruit grower faces a lot of uncertainty in producing a crop and, if there is a good crop to be picked, there is still the uncertainty of the market. There is truth in the saying that producing a fruit crop is the lesser half of the problem, post-harvest handling and marketing representing the larger half...

Hopefully you have given proper thought to all these risks, problems and possible setbacks, because this Agrodok cannot do it for you! For

one thing, the contents are limited to fruit production. Some aspects, such as out-of-season production, are related to marketing, but marketing as such is not dealt with. Local markets and customary arrangements with middlemen vary so much and the market situation changes so rapidly when the production of a new fruit increases, that marketing advice should be based on local conditions.

In Chapter 8 the principles of controlling pests and diseases are discussed with some examples. Finally, if you have considered all the above objections and still are about to plant fruit trees, you will find recommendations in Chapter 10: Layout and establishment of the orchard.

2 Cropping systems for fruit

Fruit is produced in almost every farming system. Some fruits are collected in the natural vegetation (‘in the wild’). In shifting cultivation systems, fruit trees are often planted along with the field crops after a plot has been cleared. During the first year or two of the next fallow period the resurging natural vegetation is slashed to enable the fruit trees to survive and bear fruit. In this way Amazon Indians enrich the fallow vegetation with a range of indigenous fruit crops, such as canistel, Amazon tree grape, pejibaye and other palms.

2.1 The home garden

From the more permanent plot around the hut of the shifting cultivator to the home garden of the settled farmer is only one step. The original meaning of the word ‘garden’ (as well as ‘hortus’ from which ‘horticulture’ is derived) is ‘fence’ or ‘enclosure’. Horticultural crops are grown within the enclosure, field crops outside it. The enclosure offers protection so that the family, not passing goats and school children, can gather the harvest. There are a great many garden crops. They are grown on a small scale – partly because they are perishable – and together they fill the garden throughout the year, making protection all the more necessary.

Protection is easiest if the garden surrounds the house: the home garden. This also facilitates crop care. Many husbandry techniques, explained in textbooks but rarely seen in the field, such as watering by hand, composting, mulching, pruning, trellising and simple crop protection measures, are common in the home garden. Protection and care ensure that the home garden supplies small quantities of fruits, vegetables and herbs to supplement the diet, but also medicinal products, some fodder for the animals, and amenities such as wooden posts and bamboos.

2.2 Orchards and plantations

Near the growing towns some home gardens developed into market gardens and further specialisation led to new professions: vegetable grower, fruit grower, nurseryman, etc., all producing primarily for the market.

However, of the many different fruit crops in home gardens only a few are found in orchards producing for the market. The reason is both simple and shocking: fruit growers cannot grow these crops profitably, because they produce too little and/or too erratically, and it takes too many years bvefore they bear fruit! Why plant an orchard of durians if you have to wait up to 10 years for the trees to produce a worthwhile crop? And look at the mango trees in your area: people notice a single tree full of fruit, but tend to overlook 10 others that hardly bear any fruit. In fact the mango, one of the most important fruit crops, bears so erratically that it is difficult to estimate what a "normal" yield is. On the other hand, pineapple and banana are so productive that investors are prepared to finance large-scale plantations of these fruits. This is shown in figure 1 where home gardening is compared with the more commercial cropping systems.

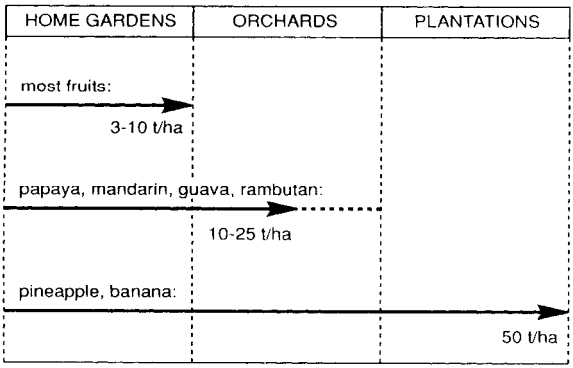

Figure 1: Cropping system, crops and yield levels. All cultivated fruit crops are grown in home gardens, but only those that bear good crops are found in more commercial cropping systems.

Some fruits are only found growing in the wild; all cultivated fruits are grown in home gardens, but only a few have made it as orchard or plantation crops. Looking more closely at figure 1 it is clear that the crops suited to production in orchards or plantations are not only high-yielding; they also need only a short period from planting to full production, and they remain small. Pineapple and banana, the 2 plantation crops, show these properties in the extreme.

2.3 Small is beautiful

High yield and early production are associated with small tree size. For the fruit grower *SMALL IS BEAUTIFUL*! This point is emphasised throughout this booklet, because traditionally people want their trees to grow *BIG*. After all the distinctive feature of a tree is its size. Big, or rather tall, is indeed beautiful for the forester. However, *as a fruit grower you are after fruit, not wood.*

Apple growing in the Netherlands provides a striking example of the move towards smaller fruit trees. From 1930 to 1970 the average number of trees per ha increased from 100 to 2,500 (the spacing decreased from 10m x 10m to 3.20m x 1.25m). In these 40 years the mean yield in the country increased from 8 to 32 ton per ha!

If trees remain small you need a lot more trees per ha, but this drawback is offset by rapid attainment of full production. Moreover, small trees are so much easier to manage: pruning, crop protection, harvesting, etc. can all be done much more efficiently. Early bearing, easy-to-manage, small trees should bring down the cost of fruit production, so that the grower can make a profit even at much lower market prices, enabling many more people to buy fruit.

Whereas control over tree size is essential for the commercial fruit grower, it is also beneficial for home gardeners. Just imagine your one large mango tree being replaced by 3 or 5 more fruitful small mango trees of different varieties! (But these trees may be too small to sit in

their shade...) Ways to control tree size will be discussed in later chapters, with emphasis on the first step, clonal propagation (Chapter 4).

2.4 Summary

Fruits play a role in almost all farming systems. Some fruits are collected in the wild, a variety of fruit crops are used to enrich the vegetation of fallow fields in shifting cultivation, and the widest variety of fruit crops is found in home gardens. Only a minority of tropical fruits are suited to commercial production in orchards. The largest commercial enterprises, such as corporate plantations, are virtually limited to pineapple and banana. Commercial fruits crop heavily and regularly; usually they come into bearing quickly and the trees remain small.

Progress in fruit growing relies strongly on methods to limit tree size, because small trees tend to be more productive than large ones and are much easier to manage, leading to lower costs of production. The principal method to achieve this is by vegetative propagation.

3 Form and function

3.1 Single-stemmed and branched fruit crops

There are a few fruit crops that come to the fore wherever the growing conditions permit their cultivation: papaya, coconut, pineapple and banana. The growth habit of all these plants resembles a single, giant shoot. That is why we call them single-stemmed plants (although, strictly speaking, this is not correct – see Box). This shoot grows continuously, the growing point at the shoot tip forming leaves and inflorescences in orderly succession.

Papaya and coconut form flowers in the axil of every leaf, pineapple and banana flower at the shoot tip after sufficient leaves have been produced to sustain fruit growth.

The form of these single-stemmed crops implies that if they grow faster they will also flower and fruit sooner. Moreover, leaves and fruit grow to a larger size when growing conditions are favourable. For the grower these are relatively simple crops, because they respond well to crop care (watering, manuring, crop protection). If only you make sure that the plants grow well they will produce high and predictable yields. Because the growing point is always active, fruit can be harvested at any time of the year. So it is not surprising that these crops are grown wherever possible; they are important to rich and poor.

Different forms of branching

Banana and pineapple form suckers, which are in fact branches. However, suckers do not much affect form and functioning of the mother shoot, so here we just consider both crops (and suckering palms such as date palm and pejibaye) as single-stemmed plants. You may have seen papaya plants that through some mishap have formed a few branches. Because each of these branches resembles the unbranched papaya in form and functioning, we still include such plants in the single-stemmed category.

Branching of the true branched fruit crops is of a different order. They branch to adapt their form to the available space (branches grow towards the light). Vines are the champions in this respect; they have no fixed form at all. The form of a vine depends on the support it finds in searching for light.

Continuous and intermittent growth

The single-stemmed fruit crops are only a small, but extremely important, minority. By far most fruit crops are freely branching trees. The shoots of most of these branched species do not grow continuously but intermittently. Shoots extend during a flush, rapidly unfolding a number of leaves. Before long the shoot stops growing, no longer issuing young leaves and matures into an apparently resting twig.

Single-stemmed crop plants can grow continuously because as soon as they have a full set of leaves the leaf area remains the same, each new leaf replacing a withering leaf. Nearly all water and nutrients needed by a tree are taken up by *young* roots. That is why roots cannot stop growing; otherwise there soon would be no young roots anymore. The fairly constant leaf area of single-stemmed plants can be supplied with water and nutrients if the roots grow at a steady pace.

The roots of branched trees would have to grow ever faster if the number of shoots and leaves increases unchecked. This is impossible and may explain why most branched trees grow intermittently rather than continuously. During a flush the number of leaves increases so fast that the root system cannot keep up. After the flush, however, growth of the roots continues and leaf fall gradually reduces the leaf area. So after a period of (many) months, the tree is again able to support a flush. As a result the shoot: root ratio in branched trees is not steady, but fluctuates. Under favourable growing conditions there may be a rapid succession of flushes, so that branching becomes quite complex within a few years, as shown in figure 2.

Which buds will flower?

For the fruit grower the most striking feature of branched fruit crops is that flowering and fruiting have no well-defined place in the growth habit, in contrast to the single-stemmed crops.

A papaya or coconut that grows reasonably well flowers in every leaf axil once the juvenile period is over, but it is impossible to say which of the hundreds or thousands of twigs on a mango tree are going to