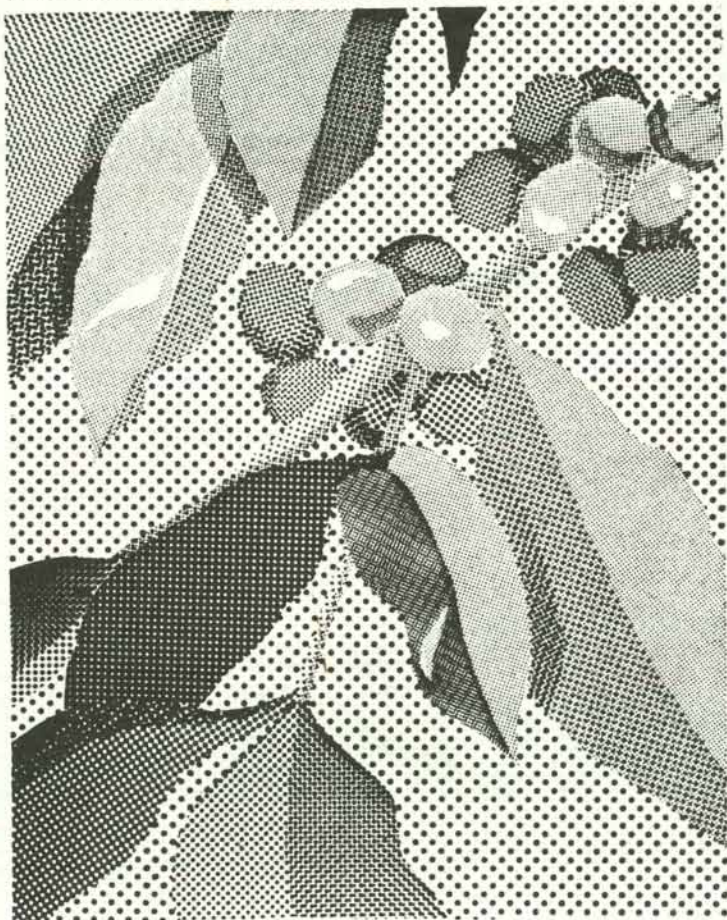


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COFFEE

## Care Of The Young Coffee Orchard

Y. BARON GOTO and EDWARD T. FUKUNAGA



Extension Circular 357

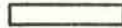
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## INTRODUCTION

Perhaps the most crucial period in the life of a coffee orchard is the first five years. During this period, the trees must be fertilized, protected against insects and other damaging enemies, and shaped for efficient growth and future production by scientific pruning practices. Weeds in the orchards must be controlled, and crops harvested. These are the "formative years," in the lives of the young trees.

Accordingly, the following pages are devoted to a discussion of some of the highlights of young orchard care.

It seems necessary, at the outset, to clear a present degree of confusion regarding the term *year* as applied to the young coffee tree. In some countries, the term is applied on the basis of the calendar year, figured from the time of germination. In Hawaii, however, a *year* or *growing year* in the life of a coffee tree, counted from the time the seedling is planted permanently in an orchard, is figured on the basis of the number of times the tree has reached the annual state of semi-dormancy.

And since semi-dormancy occurs in late December and continues through the month of January to the first rains of late February or early March, the "first year" in the life of the coffee tree is always a period of less than 12 months. This is due to the fact that the spring and summer months—late March to early June—are the best for planting because they are characterized by almost daily rainfall.

Suppose, for example, that trees were planted in Kona during the month of April. They would reach their first period of semi-dormancy in December, which would make the first "year" actually a period of eight months. If, on the other hand, they were planted in June, the first "year" would comprise only six months.

Such trees, regardless of their age as seedlings (usually from 16 to 20 months) at the time of permanent planting, would be *one year old at the time they reached their first period of semi-dormancy*. Each successive period culminating in semi-dormancy would be figured as a year in the life of the coffee tree.

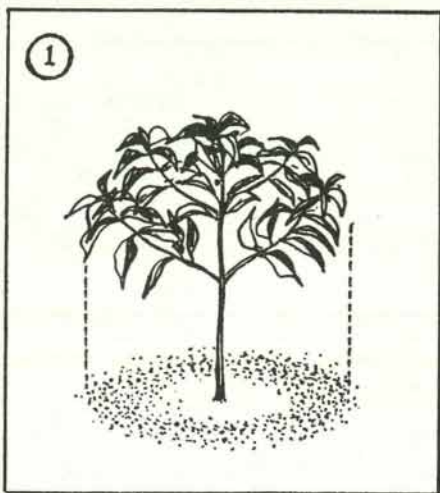
## FERTILIZING

Fertilization practices in coffee production are especially important in young orchards. The following practices are recommended for Kona.

### First Year

The main purpose of fertilizing young trees is to force vigorous and continuous root and vegetative growth. For this reason plants need a fertilizer with a high phosphoric acid content. When this is given in proper amounts and at correctly spaced intervals, the trees will respond remarkably well and demonstrate a high degree of root production and general vegetative growth.

The first application is made approximately two months after permanent transplanting, even though a liberal amount of 2-24.5-2 fertilizer had been placed in the bottom of the hole at the time of planting. The fertilizer recommended is 10-10-10 mixture, a special fertilizer. A *handful* only of this fertilizer



per tree should be evenly spread by hand, beginning a few inches from the trunk and extending to the tip of the lateral branches (Fig. 1). It is preferable, in fact, to dig holes around the tree, a foot or so away from the trunk, and bury the fertilizer in them.

The same amount and mixture of fertilizer is repeated at intervals of about three months during the first year.

First Year		
What	How Much	When
10-10-10	A handful of fertilizer per tree.	First application, two months after planting and once every three months thereafter.

### Second Year

During the second year, the lateral branches will spread out and the verticals will grow taller. The roots of the trees will extend laterally, and the quantity of fertilizer should be increased to approximately two handfuls per tree at three-month intervals. Continue to use the same fertilizer, broadcasting it evenly over the area under the branches.

Second Year		
What	How Much	When
10-10-10	Two handfuls per tree.	Every three months.

### Third Year

The trees will be four to six feet tall in the third year. As potash is necessary for flowering and fruit formation, fertilizer containing high nitrogen and potash, such as the commercial 14-7-28 is recommended from the third year on. One-half ton per acre will be satisfactory.

The fertilizer is applied by broadcasting by hand four times a year. The first application is made at the beginning of the growing season following the semi-dormant period. The second application is given immediately after the flowering period, and the third during the time the crop is making the most rapid development and vegetative growth is at its maximum. The last application is made just before harvest time.

Third Year		
What	How Much	When
14-7-28	One pound per tree.	Four times a year; February, April, June and August.

### Fourth Year

Trees are large now, and therefore the amount of fertilizer has to be increased to approximately 1500 pounds per acre, given in four applications. The high potash fertilizer of 14-7-28, is recommended. *Caution:* As the amount of fertilizer increases, more care should be exercised to evenly broadcast it over the entire area

under the branches and no closer than six inches from the trunk.

If the orchard is located in a sunny, relatively unclouded area, an additional application of up to 500 pounds of ammonium sulphate is usually given, in two applications. The first half is given between the first and the second application of 14-7-28 fertilizer, and the second half between the third and the fourth application of 14-7-28 fertilizer. In Kona, coffee orchards below the belt road fall in this category.

*Note:* Where there is excessive rainfall and cloudiness, supplementary nitrogen fertilization is not necessary.

The usual practice among experienced Kona coffee growers, whose orchards are located in areas which fall between the excessively cloudy section and the sunny section, is to apply additional ammonium sulphate to the amount of approximately 200 or 300 pounds.

#### Fourth Year

What	How Much	When
14-7-28	Three pounds per tree or 1,500 pounds per acre per year.	February, April and June.
<i>plus</i>		
Ammonium sulphate (for sunny areas and below 1,500 feet).	One pound per tree or 500 pounds per acre per year.	March, May and August.

#### Fifth Year

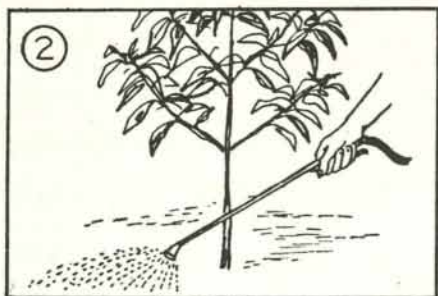
High potash fertilizer, 14-7-28, is increased to 2,000 pounds per acre as production increases. *Note:* However, if the orchard is established on exceptionally rich, virgin soil, 1,500 pounds or even less will probably be sufficient.

Increase the additional ammonium sulphate fertilizer from 500 to 800 pounds per acre in the sunny areas, and up to 400 pounds in the intermediate areas.

#### Fifth Year

What	How Much Per Annum	When
14-7-28	Four pounds per tree or 2,000 pounds per acre per year.	February, April and June.
<i>plus</i>		
Ammonium sulphate (for sunny areas below 1,500 feet)	500 to 1,000 pounds per acre per year depending on sunlight.	March, May and August.
or		
for intermediate areas 1,500 feet to 1,700 feet elevation.	400 pounds per acre.	March, May and August.

## WEEDING



Weeding is a very important cultural practice. If it is neglected, no amount of fertilization will help. But given proper climatic conditions, adequate and timely fertilizer applications, and careful weeding, coffee trees will grow vigorously.

In the past, experienced coffee farmers have protected the area near the trunk of the tree with mulch, consisting either of coffee parchment skin, flat stones, or

dried grass. This keeps the weeds away from the area where the feeding roots are most numerous. During the dry season, it helps in keeping the soil moist, particularly at the lower elevations, and since hoeing or hand weeding is expensive, this method is a very good way of minimizing the expense of weed control during the first year. **Check with your local county agent for current herbicide recommendations.**

## INSECT CONTROL

Thus far Hawaii is fortunate in having neither coffee diseases nor insect pests of any serious consequence. Such little as we have is now under effective biological control. There is, however, one insect enemy, the green scale,<sup>1</sup> which requires constant attention when the coffee trees are young (Fig. 3, opposite page).

This pest made its first appearance in Kona in 1905.<sup>2</sup> It lives and multiplies by sucking the sap from the leaves and green growing stems of the coffee plant, stunting the plant through starvation, and sometimes even killing it when the number of green scales becomes numerous. It excretes and spreads a thin coating of sweet liquid, or honey dew, on the leaves and the green stems, which supports the growth of a black mold.

By clogging up the breathing pores (*stomata*) of the leaves, and by reducing the amount of sunlight on the leaves, this black smut prevents the leaves from functioning normally, and the tree gradually weakens.

Each adult female green scale lays an average of approximately 800 eggs. The newly hatched young insect moves around, while at the adult stage it is rather stationary. It is while the young insect is moving around freely that the ants pick it up and carry it from one tree to another or from one stem to another. In this way the green scales are spread in the orchard.

These scales are to the ants like a milk cow to a human being. The ants are attracted by the sweet excretion of the scales, which they greedily devour. They move from one stem to another, from one tree to another, as human beings move cows from one pasture to another. The ants protect them from their natural enemies and are responsible for their spreading. By controlling ants, the spread of green scales can be effectively checked, and the elimination of the pest by natural enemies is encouraged.

Fortunately, there are many natural enemies of green scale, particularly in Kona, which help in reducing the damage rendered by this pest to such an extent

<sup>1</sup>*Coccus viridis*

<sup>2</sup>Insects Affecting Coffee in Kona, Hawaii, Extension Bulletin No. 9, January, 1931

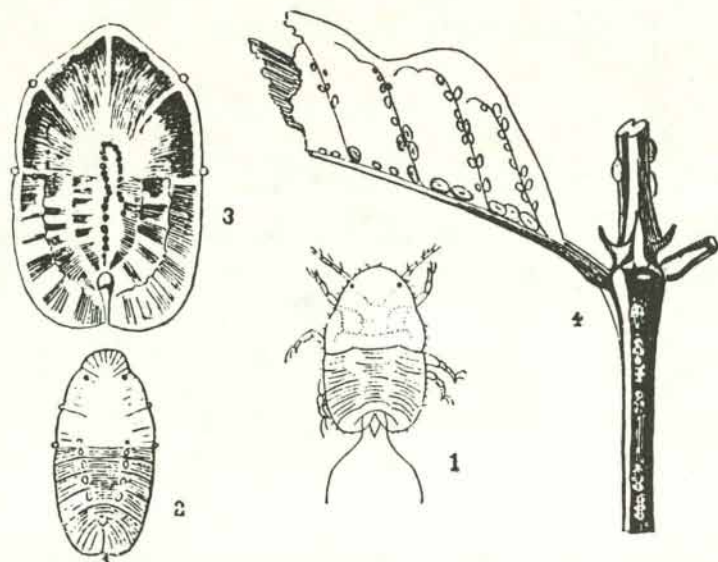


Fig. 3—*Coccus viridis* (Green) The green scale, showing stages in its development. 1, newly-hatched young female scale insect; 2, female of second stage; and 3, adult female; all greatly magnified. 4, scales on branch of coffee plant, natural size (after Green).

that, most of the time, it is not a major problem. Among the parasites in this group are tiny wasps which lay eggs in the scales and kill them. They are so small that their presence is usually not detected.

There are also two species of ladybird beetles which were introduced in 1895 to attack other scale insects, which eat a large number of green scales and contribute effectively to their control.

The most effective parasite, however, is a fungus which kills the green scale during the wet periods. The scales which have died from the attack of this fungus show a whitish fringe around them. Under normal conditions it has been observed that these fungi, with the cooperation of other parasites, reduce the population of green scales to a minimum.

#### GROWTH AND FRUITING HABIT OF THE COFFEE PLANT

The coffee tree has two distinct types of branches: the vertical, known as the *orthotropic*, and the lateral, or *pleiotropic*. The first shoot emerging from a seed is orthotropic and becomes a vertical. As the vertical grows, it produces lateral branches from buds produced in the axil of each leaf on the vertical. Sometimes there are three laterals at each node on the vertical, but a pair is more usual. Below each lateral branch are other buds which may develop into vertical branches under certain conditions. The basic difference between the vertical and the lateral branch is its growing habit, the former always growing straight up and the latter always shooting out horizontally.

As the vertical elongates, more laterals are produced at each new node. The elongation of the vertical and lateral branches is most rapid during the rainy summer months. During the dry months, growth stops. When new growth resumes, the vertical will grow taller while the laterals, in addition to growing longer, will produce more laterals from growth made the previous season. These lateral branches



Fig. 4. 1—vertical. 2—Primary lateral. 3—Secondary lateral. 4—Tertiary lateral. Numbers 3-6 usually called sublaterals.

which grow from the main, or first side-branches, are called *secondary laterals*, while the main side-branches which grow at the nodes of the verticals are called *primary laterals*.

As the cycle is continued, the primary laterals produce more secondary laterals and the secondary laterals themselves produce additional branch laterals. The side-branches which grow out of the secondary laterals are called *tertiary laterals*. These will in turn produce further side-branches on themselves if the tree is left unpruned.

For the sake of convenience, all laterals with the exception of the primary laterals are usually called "sub-laterals". This includes the secondary, tertiary and subsequent side-branches which develop on each succeeding generation of laterals. Thus, as the coffee tree gets older, the main vertical becomes surrounded by a mass of intertwined and crossed sub-lateral branches (Fig. 4).

Fruiting occurs at the nodes of both the laterals and the vertical, and under normal conditions fruits are produced only once at each node. Fruits on the verticals are few and inconsequential, while good fruits are produced at every node on the bearing wood of the laterals if sunlight is adequate.

As reported previously, coffee trees grow by the elongation of both the vertical and the lateral branches. These new, elongated stems are commonly called *growing wood*. Fruit clusters appear at the nodes of this new growth during the second year, when it becomes known as *bearing wood*. While fruit is maturing on the bearing wood, new growing wood is being produced at the end of the branch for the next crop. The size of the next crop will depend upon how much growing wood is produced during any given year.

Since the growing wood is being produced while the fruit is maturing, the



tree is taxed for nutrition simultaneously by the growing wood and the developing fruit. As a result, when the tree is overloaded with fruit, very little growing wood is produced. Since next year's crop is produced on this year's growing wood, over-bearing during one year results in a small crop the next.

On the other hand, if the crop is small this year, and the tree is able to produce more growing wood, the result will be a larger crop next year. This tendency of bearing a heavy crop one year and a light crop the following, is commonly called *biennial bearing*.

### PRUNING

The principal object of pruning young coffee trees is to eliminate this biennial bearing, by training and shaping them into a definite form or pattern and, thereafter, to maintain the same pattern.

Several years ago there were half a dozen pruning systems practiced by farmers in Kona, but today the majority of the farmers use the *multiple vertical* system (see below). In the wet, high elevation areas, where heavy rainfall and cloudiness tend to force the coffee trees into vigorous vegetative growth farmers use the topped system. However, with the high labor cost prevailing today in Hawaii, the topped system is uneconomical, requiring excessive labor for proper pruning.

### THE MULTIPLE VERTICAL SYSTEM

The multiple vertical system, by far the most popular pruning system in Kona, is developed during the first five or six years of the coffee plant's life when it is trained to conform to this pattern through proper pruning.

In this system four to eight verticals are developed on each stump. These are renewed periodically with the result that although the stump may be as old as 50 years, the actual bearing branches of the tree are only a few years old. It is customary to remove verticals which have reached the age of four or five years.

Theoretically, it is believed best to remove the verticals after the fourth year. In practice, however, farmers "evaluate" the verticals from time to time, and if one has become too tall for easy harvesting or overly exhausted due to heavy bearing, it is pruned off and a new vertical allowed to develop from the stump to replace it.

All the verticals are not removed in any one year. However, what the grower is attempting to avoid is an excessively heavy crop one year, followed by an unprofitably light crop the next. To produce an evenly balanced crop, he must keep verticals of different ages on each stump, periodically removing the one or more oldest and the most exhausted, and allowing them to be replaced by new ones.

As may be seen from the above, only the main stump is permanent in this system. It is desirable to keep it as low as possible and certainly not more than two feet at any time. The four to ten verticals on this stump are renewed periodically with the older and more exhausted ones being replaced in their turn.

Accordingly, on a single stump, there will be one or two five year old verticals ready to be removed after the annual crop is harvested; one or two four year olds which will be removed the next year; one or two three year olds, bearing heavily; one or two two year olds with a small crop; and one or two one year old verticals which will be at their prime two or three years hence. Every time a vertical is removed, several new verticals sprout. One or two only, however, will be selected and allowed to grow.

How do these verticals grow?

When a vertical is removed, allow one or two new verticals to grow, depending on the vigor of the tree; if strong and vigorous, two; if weak, only one. This new vertical will grow between four and five feet during that year under ideal

conditions of fertilization, rainfall, and sunlight. There will be no coffee produced by a given vertical during the first year.

During the second year, this vertical will produce a good crop on the primary laterals which grew the first year. It will grow approximately two feet more in height and the primary laterals will further elongate, developing bearing surface for the following year. Practically no secondary laterals develop during the second year.

In the third year, the crop will be considerably larger than during the previous year, and the fruit will be borne on the second year's growth. Usually the portion of the laterals which produced the previous year will have no fruit. The vertical will grow slightly taller but the laterals will not elongate very much. However, many secondary laterals will develop and grow.

More and more crop will be produced on the secondary laterals from the fourth year on. And while this crop is maturing, there will be increased development of secondary and tertiary laterals. This change in the bearing branch from the primary to the secondary is significant because it is generally conceded that cherry from the primary laterals are large, uniform, and of high quality, whereas cherry from the secondary and other sub-laterals are smaller and less uniform. Sub-laterals also tend to prolong the harvesting season because the fruit on them usually develop later than those on the primary, which uniformly flower and ripen.

It is also much easier to pick from the primary laterals. When the secondary and tertiary laterals begin to develop, the vertical becomes bushy, with many interlacing cross branches from which it is difficult to pick fruit. Some farmers may retain verticals for as many as eight years, particularly in dry, poor soil areas where growth is poor. However, the optimum recommended replacement age is four and five years, at a maximum.

The multiple vertical system has many advantages. The fruits produced are large, of high quality, and easy to pick. Cost of labor for pruning is low since it consists only of the removal of one or two verticals per tree each year.

There are other pruning systems but only the multiple vertical system of pruning shall be discussed in this circular.

## TRAINING FOR MULTIPLE VERTICAL SYSTEM

### First Year

It will be recalled that to produce a multiple vertical system tree, three methods of planting were suggested.

In the first, the seedling was planted at an angle of 10 to 30 degrees. This will start new verticals. A second method was to remove the upper half or third of the seedling at the time permanent transplanting to the orchard takes place. The third method was to use voluntary seedlings of irregular size and shape. These were to be planted at an angle after they had had some preliminary conditioning in an open nursery.

During the first year the training consists of selecting and developing four or five strong and vigorous verticals, and removing all others. The number of verticals to be allowed to grow depends on the vigor of the plant. *Note:* Special care must be taken to select the best four or five suckers. They should be well distributed, but as close to the ground as possible.

Remove all other suckers which develop or are present after the selection has been made.

### Second Year

The selected verticals alone should be carefully guarded for full development.

Any new suckers developing on the stump should be immediately and carefully removed.

#### Third Year

Remove all unnecessary suckers developing from the stump, concentrating the growth in the four or five selected verticals.

#### Fourth Year

One of the four or five verticals which have been developing during the last four years should be pruned off to develop one or two new verticals. The tallest one, or the one which appears to be somewhat exhausted from a large crop, should be selected for elimination.

Allow one or two new verticals to develop during the year (Fig. 5A).

#### Fifth Year

Remove one of the remaining old verticals to make room for one or two new verticals (Fig. 5B).

#### Sixth Year

Remove one or two of the remaining old verticals and allow new verticals to develop. This will just about start a new cycle of pruning (Fig. 5C).

No vertical should be allowed to remain on the stump longer than five years under the multiple vertical system of pruning, with four years generally considered the best time for removal.

### HARVESTING

In the lower area of the Kona coffee belt, coffee ripens from late August to December. The latter part of September to early November are the busiest months. By contrast, in the upper wet and cloudy section of Kona, the harvesting period stretches throughout the year. It is hoped that new areas being considered for coffee planting will have climatic conditions which will permit seasonal harvesting, rather than the longer, 8- to 10-month harvesting period which requires labor throughout the year and costs proportionately more.

If the coffee ripens in late fall and early winter, when the demand on sugar and pineapple labor is not too heavy, it fits into the economy of Hawaii very nicely. However, if harvesting is done throughout the year, there is apt to be a labor shortage, resulting in higher costs.

When the fruit has matured and is ready for picking, it turns slightly red. Fully ripe, it is a beautiful, glossy red, resembling the cranberry. Any fruit ranging in color from yellow to dark red may be harvested.

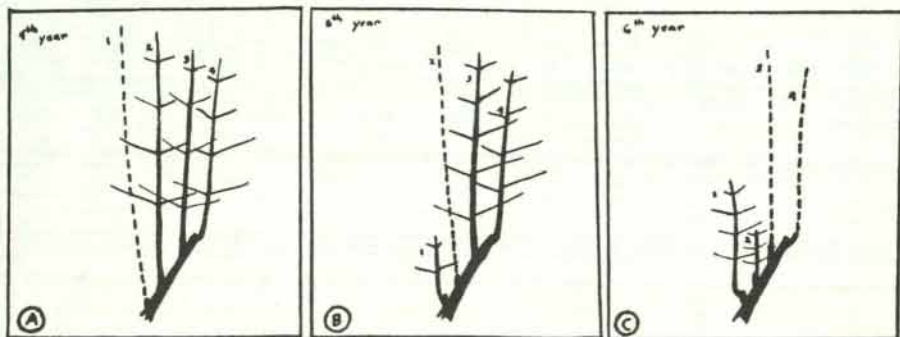


Fig. 5. (a) Fourth year. Remove vertical 1 (shown by dotted line). (b) Fifth year. Showing new growth on vertical 1, which was removed last year. Remove vertical 2 (dotted line). (c) Sixth

year. Showing new growth on vertical 1 (removed the fourth year), vertical 2 (removed last year). Remove verticals 3 and 4 (dotted lines).

Coffee harvesting practices differ in various parts of the world. Coffee is sometimes picked individually when ripe, as is done in Kona; or sometimes fruits of all stages of development are stripped at one time; and sometimes berries are allowed to ripen and are gathered from the ground after they have fallen or been shaken down. *Only ripe coffee should be picked in Hawaii, however.* It is the aim of growers in Hawaii to produce only coffee of the highest grade.

#### **Second Year**

A few hundred pounds of cherry coffee will be produced during this second year. Under prior conditions, when the price was not high enough to make it worthwhile, farmers did not bother to harvest these few scattered berries. But at today's prices, farmers who have time or many children to help, may harvest and sell this small crop profitably.

#### **Third Year**

With proper fertilization and weeding, production should be in the neighborhood of 100 bags of cherry coffee per acre.

#### **Fourth Year**

At the Kona Branch Station of the Agricultural Experiment Station, 196 bags of cherry coffee were produced in the third year. On commercial farms, a minimum of at least 150 bags of cherry coffee should be produced.

#### **Fifth Year**

If the weather conditions are favorable, and the trees are properly fertilized and weeded, 150 to 200 bags of cherry coffee should be produced.

These figures are for Kona conditions and the authors cannot vouch for similar performance elsewhere in Hawaii.



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