5.1 Planning the work

A farmer who wants to plant a new tea crop must plan far ahead. Before planting the new crop, it is first necessary to prepare planting material (either seeds or transplants), and to prepare the field for planting (by planting trees for green manure and applying compost).

So, planting a new tea crop really includes three separate activities:
1. Producing new tea plants for planting (takes about 10-15 months).
2. Planting trees for green manure (takes about 1 year).
3. Preparing and applying compost (takes about 3 months).

Before starting, the first step should be to plan a calendar of the work. The calendar of work will be different depending on whether you plant seeds or transplant cuttings. The advantages and disadvantages of seeds and cuttings are discussed later in this chapter (Section 5.3). In addition, the calendar will be different for each farmer. The reason is, each farm is a bit different (for example, different crops and livestock), and each farmer has different responsibilities during the year. Therefore, each farmer will have to plan his or her own calendar. As a guide, the following page gives some, approximate calendars for planting a new tea crop:
1. Planting tea seeds directly into the field

<table>
<thead>
<tr>
<th>Year</th>
<th>Months</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June-August</td>
<td>Make compost pile.</td>
</tr>
<tr>
<td></td>
<td>August-September</td>
<td>Prepare field (remove weeds, loosen soil, add compost).</td>
</tr>
<tr>
<td></td>
<td>September-October</td>
<td>Collect tea seeds, and plant them directly into the field.</td>
</tr>
</tbody>
</table>

2. Planting seeds in a nursery, then transplanting the seedlings into the field:

<table>
<thead>
<tr>
<th>Year</th>
<th>Months</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June-August</td>
<td>Start compost pile (if you want to mix compost with the soil in the nursery). Construct nursery to produce tea seedlings.</td>
</tr>
<tr>
<td></td>
<td>September-October</td>
<td>Collect tea seeds, and plant them in the nursery.</td>
</tr>
<tr>
<td>2</td>
<td>March-April</td>
<td>Prepare field (remove weeds, loosen soil, add compost). Plant “cot khi” trees in the field for green manure.</td>
</tr>
<tr>
<td></td>
<td>June-August</td>
<td>Start compost pile (to have compost to put into the planting holes in the field).</td>
</tr>
<tr>
<td></td>
<td>September-November</td>
<td>Transplant seedlings from nursery to field.</td>
</tr>
</tbody>
</table>

3. Planting cuttings in a nursery, then transplanting the young plants into the field:

<table>
<thead>
<tr>
<th>Year</th>
<th>Months</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June-August</td>
<td>Start compost pile (if you want to mix compost with the soil in the nursery). Construct nursery for tea cuttings.</td>
</tr>
<tr>
<td></td>
<td>August-September</td>
<td>Select mother bushes for cuttings (stop plucking and begin giving extra fertilizer). Plant “cot khi” trees in the new field for green manure.</td>
</tr>
<tr>
<td></td>
<td>October-November</td>
<td>Construct nursery for tea cuttings.</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>Take cuttings from mother bushes, plant into nursery.</td>
</tr>
<tr>
<td>2</td>
<td>May-July</td>
<td>Start compost pile to use for field preparation.</td>
</tr>
<tr>
<td></td>
<td>June-July</td>
<td>Prepare new field (remove weeds, loosen soil, add compost).</td>
</tr>
<tr>
<td></td>
<td>August-September</td>
<td>Planting the young plants from the nursery into the new field</td>
</tr>
</tbody>
</table>

This chapter would be too long if it tried to cover all these activities. So instead, this chapter will just cover how to produce and plant new tea plants. To learn about how to grow and use trees (such as “cot khi”) for green manure, see Chapter Seven. To learn how to make and apply compost, see Chapter Six.
5.2 Choosing which tea variety to plant

Most small-holders plant whatever tea variety is most common in their area.

**Advantage:** The local variety has been tested for many years by neighboring farmers. Therefore, its performance is well understood, and the variety probably is well adapted to local conditions.

**Disadvantage:** New varieties may be better than the local variety (for example, may give higher yields or be more resistant to pests and diseases).

To choose a new variety, a farmer should consider:
1. How he or she will market the tea. For example, if the buyers in the farmer’s area want to buy green tea, it does not make sense to plant a tea variety that is best for black tea.
2. How the new variety would perform in the farmer’s geographic area (soil, elevation, rainfall, etc.)

To decide which tea variety is best for their farm, farmers should consider and use the information from demonstration or experiment plots conducted by researchers or the extension service (Although plant protection services also do experiments as part of their IPM work, variety trials are most often done by the extension service). For example, on the next page is some information about varieties according to experts in Thai Nguyen. But farmers should use this information with caution. The reason is, each farm and each farmer is unique. Therefore, the tea variety that was best on a research station or on a farm in a neighboring district might not be the best for your farm. In short, no single variety will be best for everyone.

To confirm the information from the researchers or extension service, farmers should consider using experiments to decide which variety is best for their farm. Because tea is a long-lived crop, experiments to compare tea varieties can take many years. So, it may be more efficient for farmers to co-operate on a variety experiment. For example, each farmer could plant a small area of one new variety, and then farmers would compare their varieties during the next few years.
# Major Tea Varieties in Thai Nguyen: Advantages and Disadvantages

<table>
<thead>
<tr>
<th>Variety</th>
<th>Where can farmers obtain seedlings or cuttings</th>
<th>Processing for which suitable</th>
<th>Geographical conditions for which suitable</th>
<th>Advantages of the variety</th>
<th>Disadvantages of the variety</th>
</tr>
</thead>
</table>
| Mid-land broad leaf           | 1. Song Cau and Dong Hy Cooperative Tea Farms, Phu Luong District  
2. In the locality (seedlings) | Green tea                   | - Elevation less than 300 m  
- Rainfall 2000mm per year | - The major variety (>90% of all farmers grow it)  
- Good quality  
- Easy to grow, and cultivate intensively  
- Yielding: normally 5.000 - 6.000 kg/ha  
In intensive cultivation: its yield can reach 12.000 - 15.000 kg/ha |                                |
| Hybrid tea (LDP1 and LDP2)    | Tea Research Institute  
[imported from Phu Ho]  
[check this, maybe Sri Lanka?] | Green tea                   | - Elevation less than 500 m  
- Rainfall about 2000 mm per year | - Good quality  
- High yielding |                                |
| Taiwan tea                    | In experiment at Tea Research Institute  
[imported from Taiwan]       | Half-fermented tea          | - Elevation less than 500 m  
- Rainfall about 2000 mm per year  
- Able to tolerate low soil fertility  
- Very high quality | Still being evaluated by Tea Research Institute |                                |
| No. 777                       | From Tea Research Institute  
[at Phu Ho, Phu Tho Province] | Green tea/Black tea         | - Elevation more than 500m  
- Rainfall over 2000 mm per year | - High quality | - Tea doesn't look good after being processed by hand  
- More susceptible to pests at low elevations |
### Major Tea Varieties in Thai Nguyen: Advantages and Disadvantages (continued)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Where can farmers obtain seedlings or cuttings</th>
<th>Processing for which suitable</th>
<th>Geographical conditions for which suitable</th>
<th>Advantages of the variety</th>
<th>Disadvantages of the variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH1</td>
<td>Tea Research Institute</td>
<td>Black tea</td>
<td>Elevation less than 100m</td>
<td>High yielding</td>
<td>Long sleeping time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rainfall over 2000 mm per year</td>
<td>Big buds</td>
<td>Requires fertile soil and high inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good for intensive cultivation</td>
<td>Very vulnerable to bud decay disease</td>
</tr>
<tr>
<td>Japanese tea</td>
<td>In experiment at Tea Research Institute (imported from Japan)</td>
<td>Black tea</td>
<td>Elevation less than 500 m</td>
<td>Big buds</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rainfall about 2000 mm per year</td>
<td>Broad leaf</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High yielding</td>
<td></td>
</tr>
</tbody>
</table>
5.3 Choosing a method for producing new tea plants (seeds, seedlings, or cuttings)

Once you have chosen the variety, the next step is to produce new plants of that variety. Most small-holders plant seeds directly into the field. Most larger “industrial” producers use cuttings. In total, there are three methods for producing new plants, each of which has its advantages and disadvantages. Farmers should decide which is best for their needs:

<table>
<thead>
<tr>
<th>Method for producing new tea plants</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| 1. Plant seeds directly into the field | 1. Easy; no need to make a nursery. | 1. Hard to achieve a uniform population of tea bushes:  
   - If plant extra seeds as insurance against death of some seeds, must later remove some seedlings to avoid overcrowding.  
   - If do not plant extra seeds, will have gaps because some seedlings have died. |
|                                    | 2. Convenient; can plant seeds as soon as they are available, and seeds will not germinate until soil is moistened by rains. | 2. Requires frequent weeding, because young seedlings must be carefully protected from weeds until they grow to a height of at least 50 cm. |
|                                    |            | 3. Each tea bush will be different, because each seed was different. |
|                                    |            | 4. Bushes will take longer to reach the commercial stage compared to transplants from a nursery. |
## Method for producing new tea plants

<table>
<thead>
<tr>
<th>Method for producing new tea plants</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Plant seeds into a nursery, then transplant seedlings into the field.</td>
<td>1. Easy to achieve a uniform population of strong tea plants in the field (transplant only strong healthy seedlings).</td>
<td>1. Must dedicate time (10-20 months) and work to make a nursery.</td>
</tr>
<tr>
<td></td>
<td>2. Tea bushes will be a bit more alike compared to direct seeding (because farmer can eliminate any seedlings that look very different).</td>
<td>2. Each tea bush will be a bit different, because each seed was different. Even though you can eliminate any seedlings that look very different, many differences will not be visible until after transplanting the seedlings.</td>
</tr>
<tr>
<td></td>
<td>3. Requires less weeding than planting seeds directly into field, because seedlings are tall and strong.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Bushes will reach the commercial stage faster than if planted seeds directly into field.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Seedlings develop a tap root (&quot;carrot root&quot;) that can grow deep</td>
<td></td>
</tr>
<tr>
<td>3. Make cuttings from a &quot;mother bush&quot;. Plant cuttings into a nursery, then transplant them into the field.</td>
<td>1. All bushes will be the same, because all cuttings were the same. So, all bushes will have the good characteristics of the variety that you chose.</td>
<td>1. Must dedicate time and planning to prepare &quot;mother bush&quot; and make cuttings.</td>
</tr>
<tr>
<td></td>
<td>2. Other advantages are the same as for planting seeds into a nursery: - uniform population, - less weeding, - fast development to commercial stage.</td>
<td>2. Must dedicate time (10-20 months) and careful work to make a nursery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Unlike seedlings, young plants that grow from cuttings often do not develop a strong tap root (&quot;carrot root&quot;).</td>
</tr>
</tbody>
</table>

5.4 How to produce new tea plants from seeds

5.4.1 Collecting seeds

Tea bushes will flower and produce fruits if they are more than 5-10 years old and have not been pruned for a year or more. In July-August, select strong high-yielding bushes as sources of seed. Stop plucking these bushes and start giving them balanced fertilizer. This will allow the bushes to make more seeds and better-quality seeds. Tea bushes flower in October-December. The tea fruits open, and tea seeds fall onto the ground, about one year later (September-October). When the tea fruits are matured and starting to open, collect the fruits to obtain the seeds.
Why not continue plucking the bushes from which you harvest seeds?

As with any decision, there are advantages and disadvantages to continuing to pluck the bushes from which you plan to harvest seeds. The advantages are:

- **Short-term profit.** You can continue to sell the tea that you pluck from these bushes.
- **Convenient;** no need to give special treatment to the bushes from which you harvest seeds.

But the disadvantage is that you are putting a lot of stress on the tea bush. Each bush uses its leaves to produce energy (starch) from the sun. The more leaves that a bush has, the more energy it can produce. Then, each bush must divide its energy among many tasks, including growing new leaves, new roots, and new seeds.

Plucking the bush has two effects:

- The bush has fewer leaves, and therefore can produce less total energy from the sun.
- The bush must use part of its energy to grow new leaves, to replace the leaves that were plucked.

The result is, the bush has less energy to use for growing seeds. Therefore, the bush will produce fewer seeds, and produce seeds that have less stored energy (less starch and oil).

Taking into consideration these advantages and disadvantages, it is probably best not to pluck the bushes from which you plan to harvest seeds.

5.4.2 Choosing seeds

Some bushes produce larger seeds, and some bushes produce smaller seeds. Differences in seed size between bushes (or between varieties) will not affect the vigor of the seedlings, so don’t worry about it. However, even the seeds collected from a single bush will include some smaller and some larger seeds. From each bush, farmers should discard the smallest seeds (for example, by placing the seeds in a basket and discarding any seeds that fall through the basket). These small seeds will produce small, weak seedlings.

Seeds that are large enough to be useful should then be placed in a container of water. Any seeds that float on top of the water should be discarded. The floating seeds are usually dried out or have been damaged by insects. Most of the seeds that sink or remain suspended under the surface of the water are good. Nonetheless, the farmer should examine these seeds, and eliminate (throw away) any that are punctured or cracked.

5.4.3 Saving seeds

When stored, tea seeds can lose their ability to sprout. So, tea seeds should be planted as soon as possible. If seeds must be stored, do not expose them to sunlight, and keep them in a cool and shaded place. If seeds dry out, they lose their ability to sprout.
Advantages and disadvantages of high planting densities

The main advantage is that closely planted tea covers the ground quickly and more completely. This has several results:

- Higher yields when bushes are young. During the first few years of plucking, the highest yields come from densities of 22,000 up to 30,000 bushes/hectare. In contrast, lower densities do not use sunshine efficiently, because they have not yet covered the soil.
- Better protection of the soil against erosion.
- Reduced cost of weed control (dense tea bushes shade out the weeds).
- Less need to fill gaps with additional plants (because any gaps are quickly filled by the growth of neighboring bushes).

The main disadvantage of close planting is growth suppression. Individual bushes have smaller stems, fewer branches, and smaller and shallower root systems. This has several results:

- Lower yields when bushes are older. Older, larger bushes compete with each other for water, light, and soil nutrients. After the third year, tea fields with lower planting density (10,000 - 15,000 plants/ha) will yield higher than those with high planting densities (25,000 - 30,000 plants/ha).
- Small and shallow root systems make plants more susceptible to drought.
- Plants become degraded more quickly, and require replanting sooner.

Taking into consideration these advantages and disadvantages, the optimum planting density is probably between 10,000-15,000 bushes per hectare. The exact density will depend on the conditions of each farm.

5.4.4 Planting seeds directly into field

Tea seeds are usually planted as soon as they are collected (in September or October), to keep them from drying out. Before planting, it is necessary to prepare the field (see Section 5.6, below).

Recommended planting densities range from 10,000-15,000 bushes per hectare. Farmers should decide on the planting density depending on the steepness of the slope, the soil fertility, and the risk of drought in the field:

<table>
<thead>
<tr>
<th>Plant more plants per hectare if:</th>
<th>Plant fewer plants per hectare if:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope not too steep</td>
<td>Steep slope</td>
</tr>
<tr>
<td>Rich soil</td>
<td>Poor soil</td>
</tr>
<tr>
<td>Low risk of drought</td>
<td>High risk of drought</td>
</tr>
</tbody>
</table>

Most tea growers in Viet Nam plant double hedges with about 10-15 cm between the bushes within a row and 60-80 cm between the two rows within a hedge. Hedges are separated by alleys about 1 meter wide, to permit free movement of the pluckers.
In each site where you want a bush, loosen the soil to a depth of at least 60 cm. Break up any soil clods and remove any undecomposed plant material (roots, leaves, etc.) Mix some compost with the soil. Plant 3-5 seeds in a triangle or circle, with about 15 cm between seeds. Seeds should be planted at a depth of 1.5-2.5 cm, with the “eye” of the seed pointing downward.

The seed and the young seedlings must be carefully protected against weeds, insects, and drought. After planting, the field should be mulched with cut grass, water hyacinth, leaves of green crops or trees, etc. The mulch should not cover all the soil. Instead, the soil directly above the seeds should be left bare so that, once the seeds sprout, the mulch will not be touching the tea stems. The reason is, the mulch gets hot and can kill the tender stem tissues. In fields where soil insects are a problem, the mulch should be kept away from the tea plant in a ring of 15-20 cm diameter (or a strip of 15-20 cm along each side of the tea row). Young plants should be given partial shade from plantings of green manure trees (see Chapter Seven).

Once the young plants are 20-30 cm tall, eliminate any that are small or weak. At each planting site, the healthy plants that remain should be managed as a single bush for pruning and plucking.

5.4.5 Planting seeds in a nursery
Instead of planting seeds directly into the field, the farmer may wish to make a nursery. For advantages and disadvantages, see Section 5.3 (above).

1. Location of the nursery
Choose a location that is:
• close to a permanent source of water
• sheltered from strong winds but exposed to sun
• close enough to your house so you can protect the nursery from thieves and animals.

In addition, it is convenient if you can choose a location close to the source of the soil (discussed later in this chapter). Avoid low-lying areas where the soil becomes water-logged.

In and around the nursery, dig shallow ditches to permit excess water to drain. To produce 1,000 seedlings, a nursery area of about 150 square meters is needed.

2. Shade for the nursery
The nursery should be protected from the sun by a shade trellis made of bamboo or wood. To support the trellis, firmly drive vertical posts of bamboo or wood into the ground at intervals of 2-3 meters. The tops of the poles should be 150-160 cm above the ground (or whatever height is convenient for working in the nursery). Then, make a frame of horizontal bamboo cross-pieces on top of the poles. Finally, the shade is provided by thinly spread grasses, palm leaves, or ferns tied between thin strips of bamboo that are firmly tied on the top of the bamboo cross-pieces. The shade trellis should be strong enough to withstand heavy winds.
Shade for the nursery can be provided by making a frame of bamboo and covering it with mats woven from grass, or with other materials. This nursery contains cuttings planted in plastic bags.

Source: original photograph by Michael Zeiss.

3. Use of net houses

An alternative way to protect nurseries of young tea plants is to build a frame or cage made from wood or bamboo over the young plants. Then, this bamboo frame is covered with fine net cloth. The net cloth allows light and fresh air in, but prevents insects from entering the crop from outside. Of course, net houses do not prevent insects that are already on the cuttings when they are brought from the mother plants.

Although initial investment for preparing the net houses is high, savings from reduced sprayings can make it interesting. When properly prepared and maintained, net houses can be used more than once. Inside a net house, the temperature may be a bit lower due to shading effect of the net and the humidity may be a bit higher than outside. This may result in a quicker growth of the crop but it may also result in some more disease problems.

Related exercises from CABI Bioscience/FAO manual:
2-B.9. Roofing and screening of seed beds

4. Collecting soil for the nursery

Soil for the nursery should be red-brown in color, slightly to medium clay, with little organic matter and a crumbly texture. If the soil contains too much clay, it can be improved by adding sand. Soil pH should be between 4.5 and 5.0 (never above 5.5). Do not use soil in which tea was planted recently, because it may contain tea diseases.

There are 3 things that farmers can do to reduce problems caused by soil diseases (such as fungi or nematodes).
1) **Remove the surface layer of soil.** The surface layer of soil, where the roots of weeds and other plants live, may contain root diseases. Therefore, farmers should always remove the surface soil before collecting soil to use in the nursery. Normally, the surface layer is discarded and only the lower layer is used. If it is necessary to use the surface layer of soil, it should be removed and set aside so that it can be used to fill the bottoms of the planting containers (see drawing below). [check translation of "planting containers"; they are usually plastic bags. Vuong suggests "tui bau" instead of "hom che"]

![Soil and weeds in a nearby field](image1)

Cutting is planted in soil from lower layer, which has less diseases.

Bottom of the container is filled with soil from surface layer.

Surface soil should be put only in the bottoms of planting containers, to avoid infecting seedlings or cuttings with soil-borne diseases.

*Source: original drawing by Wendy Gibbs.*

2) **Mix some compost with the soil.** Farmers should experiment with mixing some compost with the nursery soil. In many crops, using compost in nurseries helps control root diseases. If you sterilize the soil (#3, below), then add the compost after you finish sterilizing.

3) **Sterilize the soil using heat from the sun.** If you are worried that the soil might contain diseases, and you cannot choose another source of soil, then you can sterilize the soil before using it. To do this, use a shovel or hoe to form the soil into a low smooth bed (like a seedbed for vegetables). Wet the soil thoroughly. Then, cover the bed of wet soil tightly with a sheet of clear plastic (polythene). The plastic sheet should rest on the surface of the soil. Bury the edges of the plastic sheet under the edges of the soil bed, to avoid losing heat. The sun heats up the soil through the plastic, and the plastic keeps the heat inside the soil. The sheet should be left on the soil for about 4 weeks, and then the soil will be ready to use.

![Solarization](image2)

**Solarization:** the sun heats up the soil under the plastic sheet and kills insects, diseases and some weeds.

5. **Filling the containers**

It is very convenient to plant the seeds in plastic bags (size 8 x 12 cm). However, seeds can be planted in any available containers, or even in the ground of the nursery. If you are using the surface layer of soil, put it in the bottoms of the containers (see the drawing above).

Several weeks before you plant the seeds, fill the bags or containers with soil and arrange in rows in the nursery. Let the filled containers stand in the rain (or water them). This will allow the soil to settle in the bags or containers. After the soil has settled, add more soil as needed.

6. **Planting the seeds**

Seeds should be planted at a depth of 1.5-2.5 cm, with the “eye” of the seed pointing downward. Some tea seeds may sprout within a month of planting, while others may take several months to germinate. Some seeds will fail to sprout. To avoid wasting containers, the farmer can plant some extra seeds in the ground in the nursery. Then, these seedlings can be transplanted into any containers in which the seed failed to sprout. Or, pre-sprout the seeds before planting them in containers. To pre-sprout seeds, place them on a bed of clean moist sand, then lightly cover them with more sand. Keep the sand moist and protect it from direct sun. Check the seeds every 1-2 days. In seeds that have begun to sprout, the tough seed coat will crack. These cracked seeds should be planted. The root will emerge a few days after cracking, but it is best not to keep seeds in the sand until the roots appear, because the young roots can be damaged when the seed is planted. Any seeds that have not cracked should again be covered with sand and examined every 1-2 days.

7. **Taking care of the seedlings**

Water the seedlings frequently, keeping the soil moist but not saturated. If you irrigate the nursery with water from streams that flow through tea plantations, the silt that is suspended in the water may be contaminated with root diseases or nematodes that infect tea (see Section 11.4). Therefore, it is recommended to let the water stand in a container for 2 days before using it, so that the silt (and the tea diseases) can fall to the bottom of the container.

Inspect the young plants frequently, and control any insect pests (for example, by hand-picking). Seedlings that are infected with disease should be removed before the disease can spread to neighboring seedlings. Once the plants have several leaves, begin applying balanced fertilizer once every two months. Spray the plants with clean water after fertilizing to wash off any fertilizer particles sticking to the tender leaves.

Plants are usually ready to be planted into the field about 10 months after sowing seeds (can range from 8-12 months). About four months before planting, start taking away the shade little by little so that the plants develop resistance to the sun. Then, remove the shade completely on days that are cloudy and cool (put a little shade back on days that are sunny and hot). For the final 1-2 months, the seedlings should not have any shade.

5.5 **How to produce new tea plants from cuttings**

5.5.1 **Preparing mother bushes**

Make mother bushes from a tea variety that is suitable for your farm (see Section 5.2). In August-September, choose healthy, vigorous bushes to use as mother bushes. These bushes should not have been pruned in the past 4-9 months. Stop plucking these bushes, and start applying extra fertilizer.
Calculate how many mother bushes to prepare based on:
- each mother bush can produce 100-150 cuttings per year,
- to plant 1 hectare of new tea will require about 22,000-28,000 cuttings (approximately twice as many cuttings as the number of plants required, to allow for some cuttings that will fail to root).

5.5.2 Making cuttings
Cuttings should be taken in November-December (2-3 months after plucking stopped). Take cuttings on a cool cloudy day. Take the cuttings from the primary shoots (the shoots that you would usually pluck). The middle portion of the shoot, which is neither too soft nor too hard, makes the best cuttings (see drawing). The topmost 2-3 tender leaves are too soft to make good cuttings. Also, the bottom leaves on the hard and rough reddish-brown portion of the stem are too hard.

Each cutting should be a 3-5 cm length of stem with one healthy leaf (free of insects and diseases). Using scissors or a sharp knife, cut the stem diagonally about 0.5 cm above and 2.5 cm below the leaf. Both cuts should be parallel to the leaf (see drawing above). If cuttings are made with scissors, be careful not to pinch or bruise the stem.
**Why just one leaf per cutting?**

The answer is, because cuttings with more leaves lose too much water and dry out.

A cutting without roots is very delicate. As a seedling grows, it draws on food (starch and oil) stored in the seed. But a cutting does not have a store of food. Instead, it must rely on its leaf to produce food from photosynthesis. The cutting uses the food produced by its leaf to grow roots and new leaves.

So, why not make cuttings with several leaves? Wouldn’t extra leaves make more food for the cutting? The problem is, the cutting is vulnerable to drying out. Until it grows roots, the cutting can only absorb a tiny amount of water from the soil. And if the cutting dries out, its leaf cannot carry out photosynthesis to make food. The cutting loses water through its leaves, so the more leaves it has, the more water it loses.

Experiments in India have shown that cuttings with more than one leaf lose too much water, and dry out. Once they dry out, none of their leaves can produce food, and the cutting dies before it can grow roots. So, the best cuttings have only one leaf. They produce only a little food, but they don’t dry out. If you want to test this, try it yourself: make several cuttings with 1, 2, 3, or more leaves. Then, compare how many of each type of cutting successfully grow roots and survive.

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### 5.5.3 Planting cuttings in a nursery

The nursery and containers (plastic bags) should be prepared as described for seeds (above). Before putting the cuttings in the containers, water the soil until saturated. Plant the cutting with the stem straight or slightly slanted so that the leaf does not touch the soil (if it does, it may become infected with diseases). Once the cutting is planted, align the container so that the leaf is parallel with the wind (the most common wind direction).

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**Close-up of a single cutting. Can you see any mistake that the farmer made?**

*Source: original photograph by Michael Zeiss.*
5.5.4 **Taking care of the cuttings**

Until they develop roots, cuttings are much more fragile than seedlings. So, the nursery must be managed very carefully. As soon as the cuttings are planted, spray the leaves gently with water. Then, to prevent the cuttings from drying out, it is best to cover the rows of containers with a sheet of clear plastic. Bury the edges of the plastic sheet in the ground to hold in the humidity. If the humidity is adequate, the inside of the plastic sheet will be covered with droplets of water (condensation) the day after planting. Once the cuttings develop roots (2-4 months after planting), the farmer should start removing the plastic sheet for a few hours each day, during the cool part of the morning or evening. The plastic sheet should be removed for longer and longer periods each day, until after 3-4 weeks it is removed completely.

If the farmer does not wish to cover the nursery with a plastic sheet, he or she should gently spray the leaves with water every day. Continue spraying the leaves until the cuttings develop roots (2-4 months after planting).

The nursery must be continually checked to ensure that the humidity is adequate, that the cuttings are protected from diseases and insects, and that the moss that often develops on the surfaces of the containers is eliminated. Once the cuttings have roots, begin monthly applications of fertilizer as follows:

**Volume of fertilizer to be applied on each square meter of nursery:**

<table>
<thead>
<tr>
<th>Type of fertilizer</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; application</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; application</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; application</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; and later applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>8-10 grams</td>
<td>13-15 grams</td>
<td>18-20 grams</td>
<td>25-30 grams</td>
</tr>
<tr>
<td>Super phosphate</td>
<td>9-10 grams</td>
<td>14-15 grams</td>
<td>17-19 grams</td>
<td>20-22 grams</td>
</tr>
<tr>
<td>Kalium</td>
<td>6-7 grams</td>
<td>9-10 grams</td>
<td>11-13 grams</td>
<td>14-16 grams</td>
</tr>
</tbody>
</table>

Spray the plants with clean water after fertilizing to wash off any fertilizer particles sticking to the tender leaves.
Plants are usually ready to be transplanted into the field about 12 months after planting cuttings (can range from 10-20 months). About 4 months before transplanting, start taking away the shade little by little so that the plants develop resistance to the sun. Then, remove the shade completely when it is cloudy and cool (put a little shade back when it is sunny and hot). For the final 1-2 months, the cuttings should not have any shade.

It is not recommended to prune plants in the nursery, because this slows down root development.

5.6 Preparing the new field for tea

The new field should have a type of soil suitable for tea (see Chapter 3). Also, the field should have a slope of less than 30 degrees. The reason is, if the slope is greater than 30 degrees, the tea will not grow well, and it is difficult for tea growers to move around in the field to care for and harvest the tea.

As was discussed at the beginning of the chapter, farmers who are thinking about planting tea need to plan ahead. There are at least three steps in preparing a new field: ringing and cutting down any trees, planting green-manure bushes or grass, and improve the soil.

5.6.1 Ringing and cutting down trees

If the field has some shade trees, you may want to leave them alive to provide shade for the tea crop (see Chapter Seven). But if you need to cut down any trees, the trees should be “ringed” one year before cutting. “Ringing” means that a ring of bark should be stripped off all the way around the base of the trunk. This will slowly kill the tree, causing the tree to use up the store of starch in its roots. If the tree is simply cut down while it is alive, its roots will be full of starch and will provide food for many root-rot fungi to grow. These root diseases will later spread to the tea roots.

Ringing is a delicate operation. If it is not deep enough, the tree will continue to store starch in its roots. If it is too deep, the tree will die quickly with the supply of starch still intact in the roots. After ringing, allow at least one year to pass before cutting down the tree. After cutting down the part above the ground, farmers need to dig out all of the root system to a depth of about 50 cm. The purpose is to make the soil softer, so that when you plant the new tea, its roots will be able to penetrate deeper into the soil and get nutrition more easily.

5.6.2 Planting green-manure bushes or grass

If the farmer is planning to plant tea cuttings or seedlings from a nursery, it is best to plant green-manure bushes one year before planting tea. The developing green-manure bushes will:
- protect the soil against erosion,
- help control weeds,
- produce abundant leaves for green manure, and
- provide temporary shade for young tea plants.

For information about how to choose and plant green-manure bushes, see Chapter Seven. If the field you are planting was previously planted to tea bushes, and those tea bushes had problems with root-rots or nematodes (see Chapter Eleven), then do not plant green-manure
bushes. The reason is, many green-manure bushes are susceptible to root-rots and nematodes. Instead, plant grass for 18 months or more. Grass is not susceptible to tea root-rots or nematodes, and also produces lots of organic matter (from periodic cuttings) that stimulates beneficial micro-organisms. Four grasses that have given good results are:

<table>
<thead>
<tr>
<th>Vietnamese name</th>
<th>English name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>mana grass</td>
<td>Cymbopogon confertiflorus</td>
<td></td>
</tr>
<tr>
<td>citronella</td>
<td>Cymbopogon wintarianus</td>
<td></td>
</tr>
<tr>
<td>Pusa giant hybrid napier</td>
<td>Pennisetum purpureum</td>
<td></td>
</tr>
<tr>
<td>Guatemala grass</td>
<td>Tripsacum laxum</td>
<td></td>
</tr>
</tbody>
</table>

But remember, maize and upland rice are also grasses, and might be effective if the stalks and leaves were left in the field after harvest.

5.6.3 Improving the soil
The third task before planting tea is to improve the soil. Soil preparation should be done 1-2 months before planting tea. To provide organic matter for the soil, cut the branches of the green-manure trees and bury them in ditches as green manure. Ditches should be about the same size as the holes for planting tea: about 30 cm wide and 60 cm deep (see Section 5.7, below). If the soil is poor, it is also good to apply compost (up to 20 tons per hectare).

5.7 Planting the tea into the new field
Tea seeds usually are planted as soon as they are collected (in September or October), to keep them from drying out. In contrast, tea seedlings or cuttings usually are transplanted from August-November, depending on how quickly or slowly they have grown. The procedure for planting seeds in the field was already described above. To plant seedlings or cuttings from a nursery, dig a hole at each site where you want to have a tea bush. The holes should be large (approximately 30 cm diameter and 60 cm deep). Of course, this is more work than digging small holes. But, many experiments have proven that the survival rate and vigor of the tea bushes justifies the extra work. To decide how many holes to dig, see the section on planting density (above).

In clay soils, the wall of the hole may become so compacted that it confines the growing tea roots. For this reason, roughen the sides and bottom of the hole before filling it. Break up any soil clods, and remove any undecomposed plant material (roots, etc.) Mix the soil with compost. Then, remove the plant from its container and place in the hole. If plants were grown in plastic bags, always remove the plastic bag before planting. Pack the mixture of soil and compost into the hole so that the top of the soil ball around the roots is flush with the ground. Do not let the plant sink lower than ground level, because water will collect around the stem and cause rotting. Soil insects (including beetle grubs, crickets, and termites) also cause more damage to sunken plants.

After planting, the field should be mulched with cut grass, water hyacinth, leaves of green crops or trees, etc. The mulch should not touch the plant stems, because it gets hot and can kill the tender stem tissues. In fields where soil insects are a problem, the mulch should be kept away from the tea plant in a ring of 15-20 cm diameter (or a strip of 15-20 cm along each side of the tea row). Young plants should be given partial shade from plantings of green manure trees or other plants (see Chapter Seven).