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Planting Tree Crops

Practical Guide to Dryland Farming

Published by: World Neighbors
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Oklahoma City, OK 73112

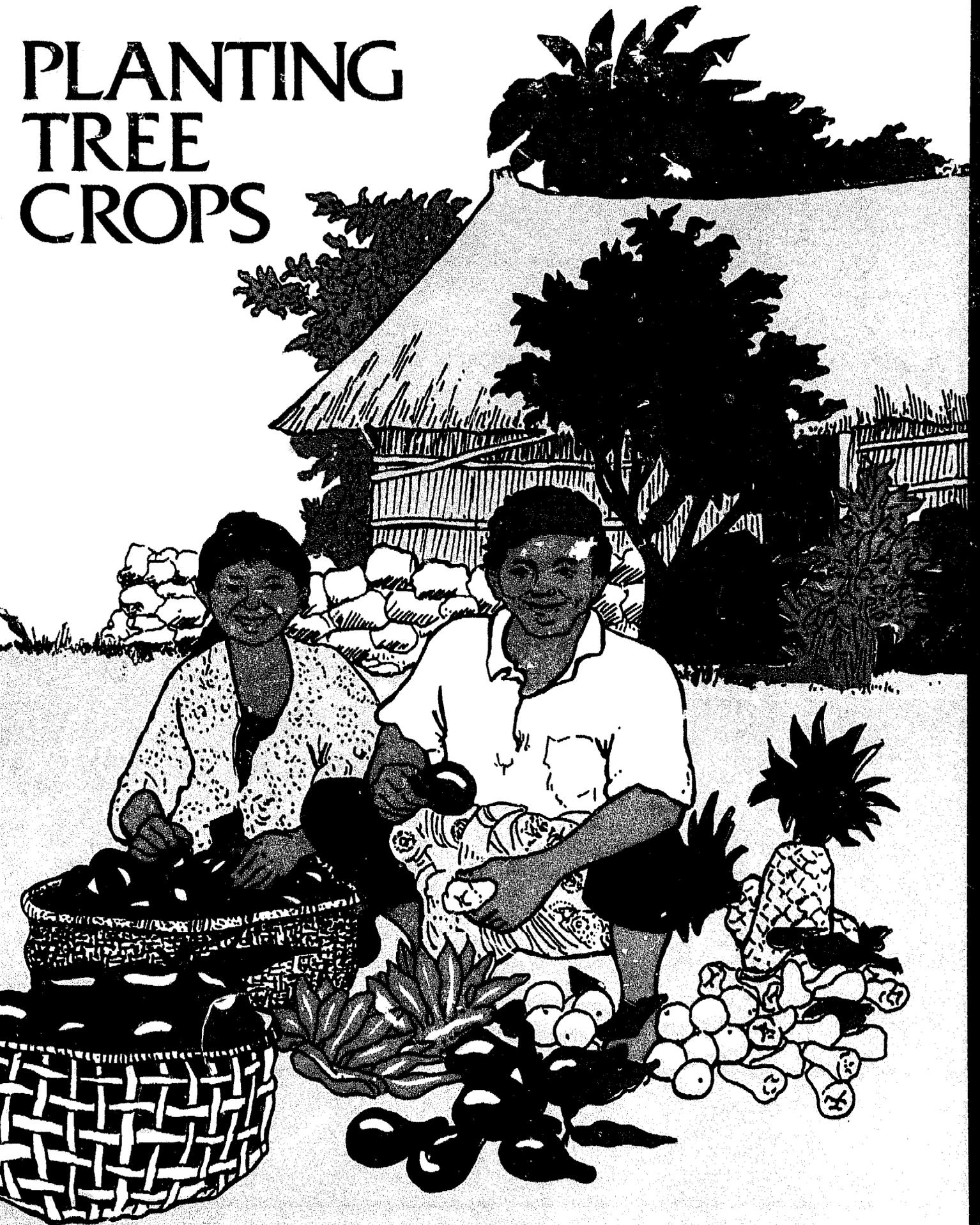
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Practical Guide to Dryland Farming

PLANTING TREE CROPS



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Planting Tree Crops is number four in the **Dryland Farming Series**, a set of booklets initially put together for upland farmers in the Nusa Tenggara Provinces of southeastern Indonesia. Other booklets in this expanding series cover aspects of farm management such as soil and water conservation, animal husbandry, integrated farming, and on-farm development experimentation.

The **Dryland Farming Series** is a collaborative effort between World Neighbors and Studio Driya Media in Indonesia, with additional input from several grassroots programs working throughout the region. These booklets were designed to be used together with farmers, extension agents, or program personnel who are already somewhat familiar with the practices described. The methodologies described are specifically applicable to the conditions found in the semi-arid regions of southeastern Indonesia; some of the practices, therefore, may not be applicable in areas with different

climates, soils, or farming traditions.

The use of common names for a variety of tree species poses some problems in translation, since English common names may indicate different tree species in different parts of the world. For this reason, the text relies primarily on scientific genus and species names to describe various trees.

If you have any questions about the material contained in this publication or others in the **Dryland Farming Series**, please contact World Neighbors. Comments and suggestions are welcome as well!

English language versions* of the **Dryland Farming Series** can be ordered from:

World Neighbors
5116 North Portland Avenue
Oklahoma City, OK 73112, U.S.A.

Indonesian language versions can be ordered from:

Studio Driya Media
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*Not all booklets in the series are available in English.



Planting trees is an important activity for most small farmers throughout the tropics. It makes good sense for farmers to integrate tree crops into their usual agricultural activities of planting food crops and raising livestock.



Economically important trees such as coffee, cloves, cacao, and coconut often become an important source of income for families at times when other crops are not yet ready for harvest, such as at the end of a long dry season.



Fruit trees provide a healthy and tasty supplement to our diet. Who doesn't like bananas, guavas, mangos, or avocados? Fruit can also be sold at the market as an additional source of income.



Most rural families need a dependable supply of firewood for cooking and/or heating the house. Wood may also be necessary for building houses or furniture, making fences, etc. As the forests in many rural areas begin to disappear, farmers must begin to think about planting trees that will fulfill their needs for fuelwood and building materials.



Some kinds of trees can provide a nutritious source of fodder for livestock. For example, species of **Calliandra** and **Leucaena** (ipil-ipil), or **Gliricidia sepium** (madre de cacao) can continue to feed farm animals during the long dry season when other sources of fodder become scarce.

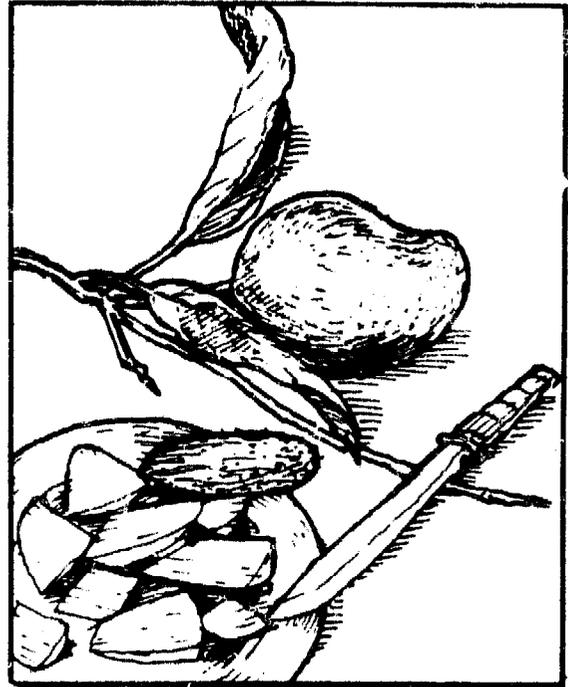


This booklet discusses some of the basic steps in the planting and care of trees. It can be used as a "planning guide" for integrating appropriate tree crops into the regular activities of the small farm.



The simplest and most familiar way to grow a tree is to plant it from a seed. In order to guarantee good growth and yield though, care must be taken to select the best seeds for planting.

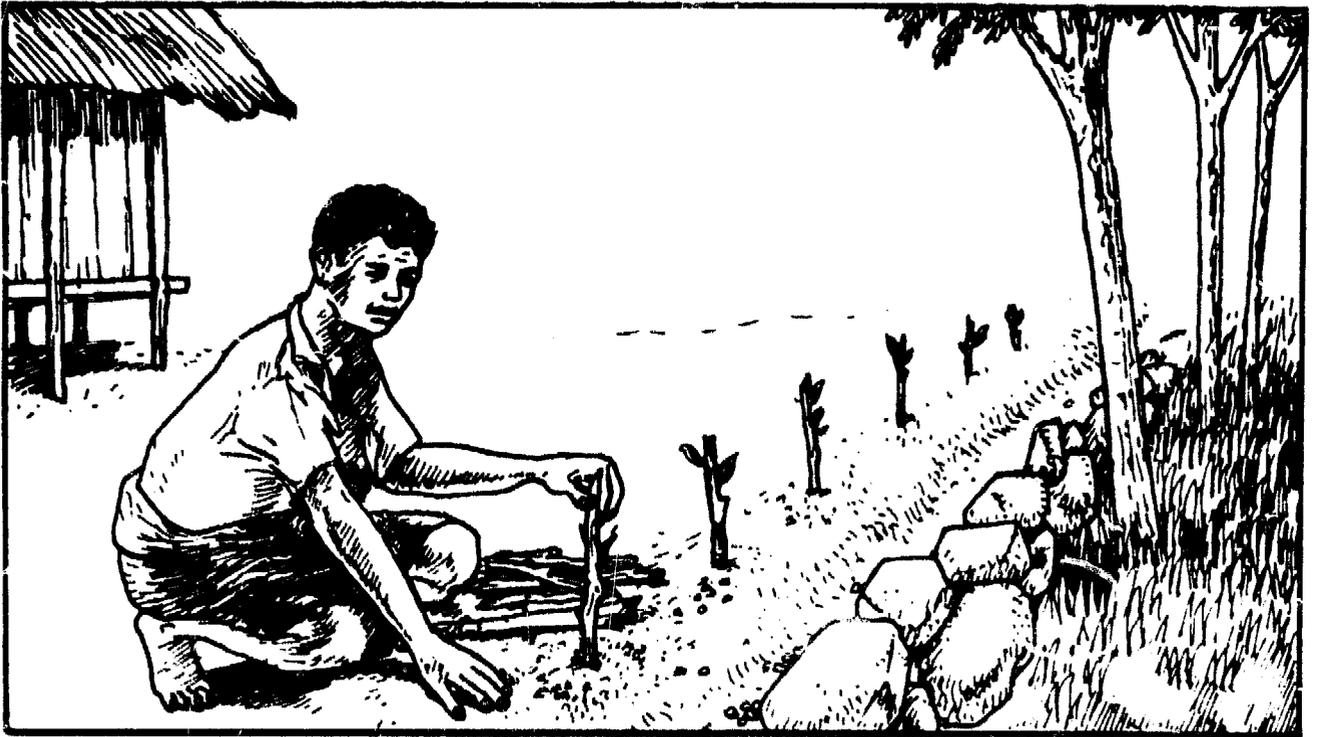
Seeds should be selected from a mature tree that has all the qualities that we want the new tree to have. The mature tree should be healthy, free from insects and disease, and have already proven to give high yields of fruit, wood, or leaves (depending upon the uses of the tree).



The best time to select seed for planting is when the fruit is fully ripe so that the seed will germinate quickly. A seed will generally grow into a tree much like the one from which it was taken UNLESS the mother tree is a "hybrid" or was "grafted".



Some kinds of seeds need special treatment such as drying, peeling, or soaking in hot or cold water in order to germinate. Others must be stored for some time before they will germinate. This type of information can be obtained from knowledgeable farmers, program workers, or agricultural extension agents.



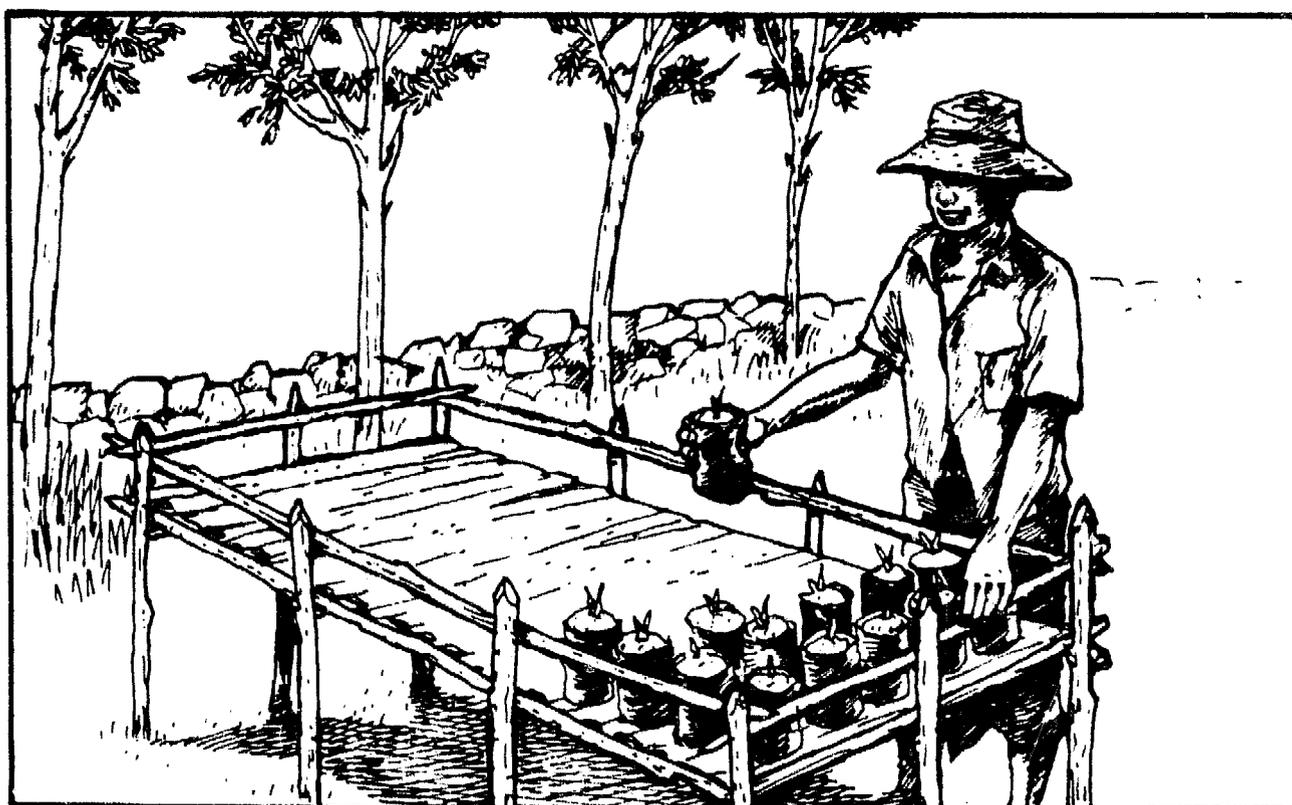
Some types of trees can be planted directly from "cuttings" or "stakes". Farmers often use stakes for planting living fences from various species of **Gliricidia**, **Erythrina**, and **Lansea**.



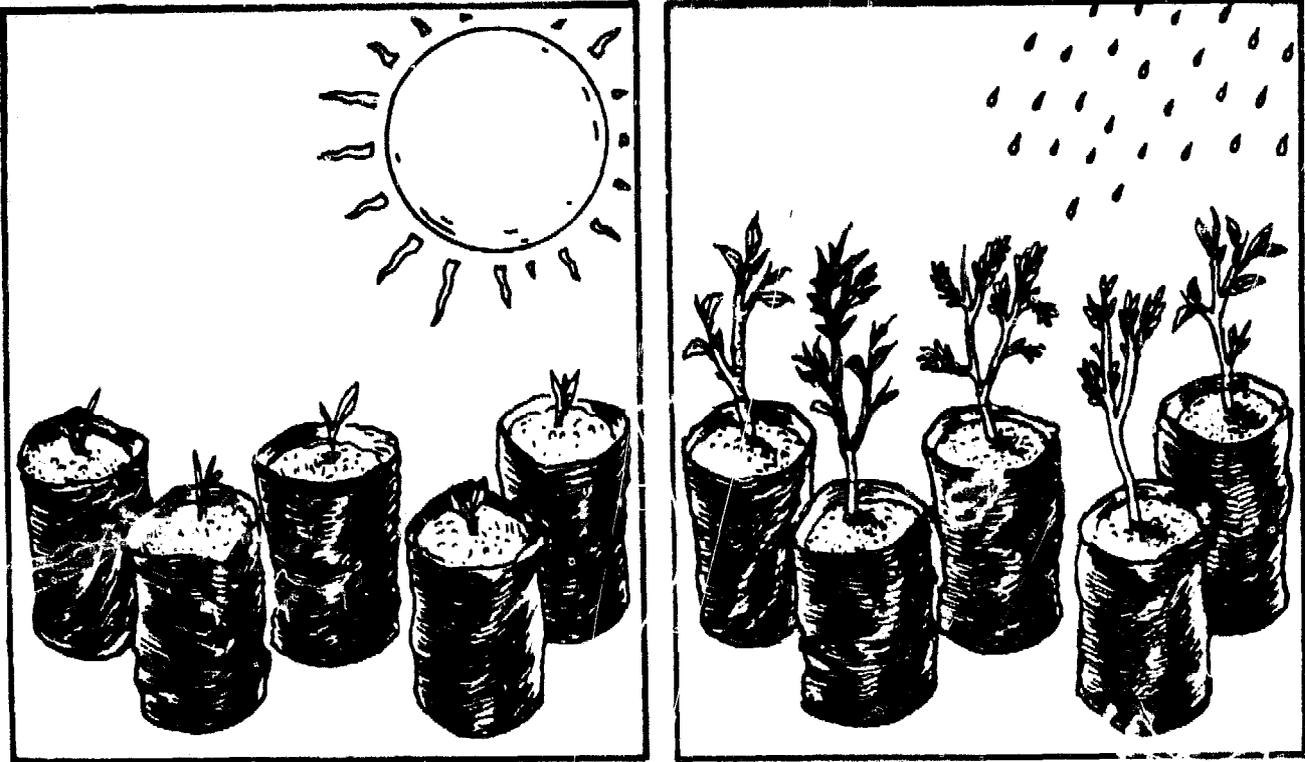
Fast-growing trees used for fuelwood (such as those of the genera **Leucaena**, **Albizia**, and **Acacia**) are usually planted directly from seed. In very dry areas, it may be better to grow these trees first in a "nursery".



Other kinds of tree crops that are not strong enough to be planted directly in the field should be planted first in a seedbed or nursery, too.



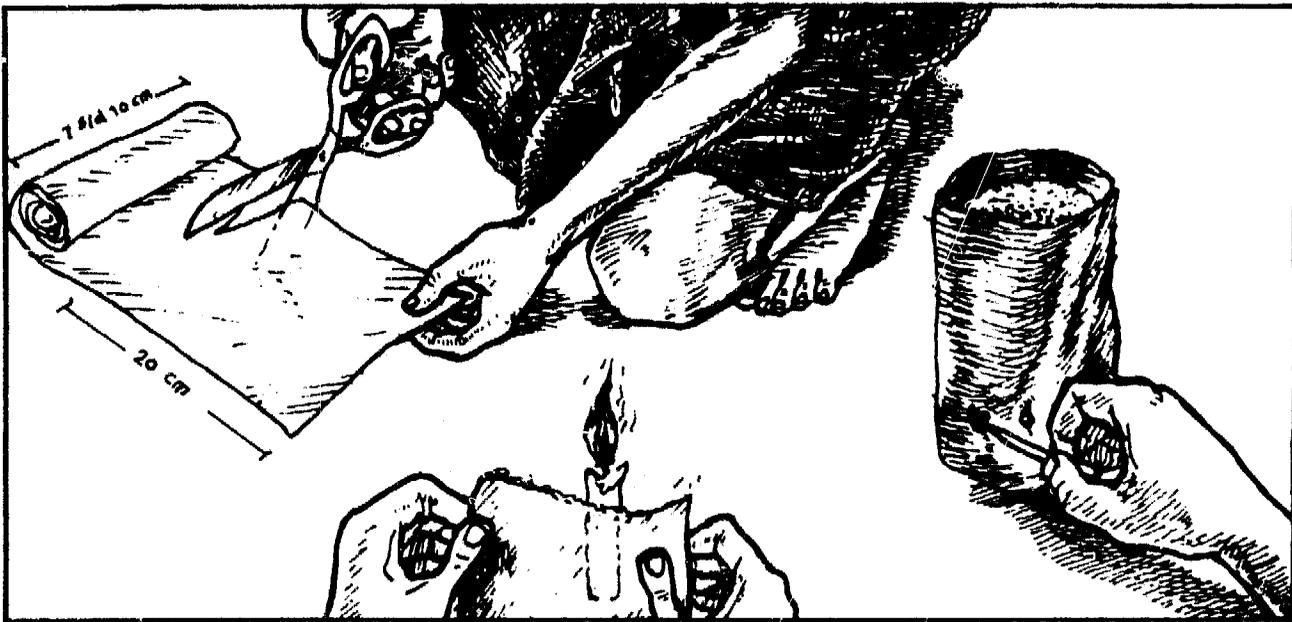
Planting seeds in a nursery has other uses as well. Both time and water can be saved. Seedlings can be cared for better in the nursery. Seeds can also be planted during the dry season instead of waiting for the onset of the rains to plant them.



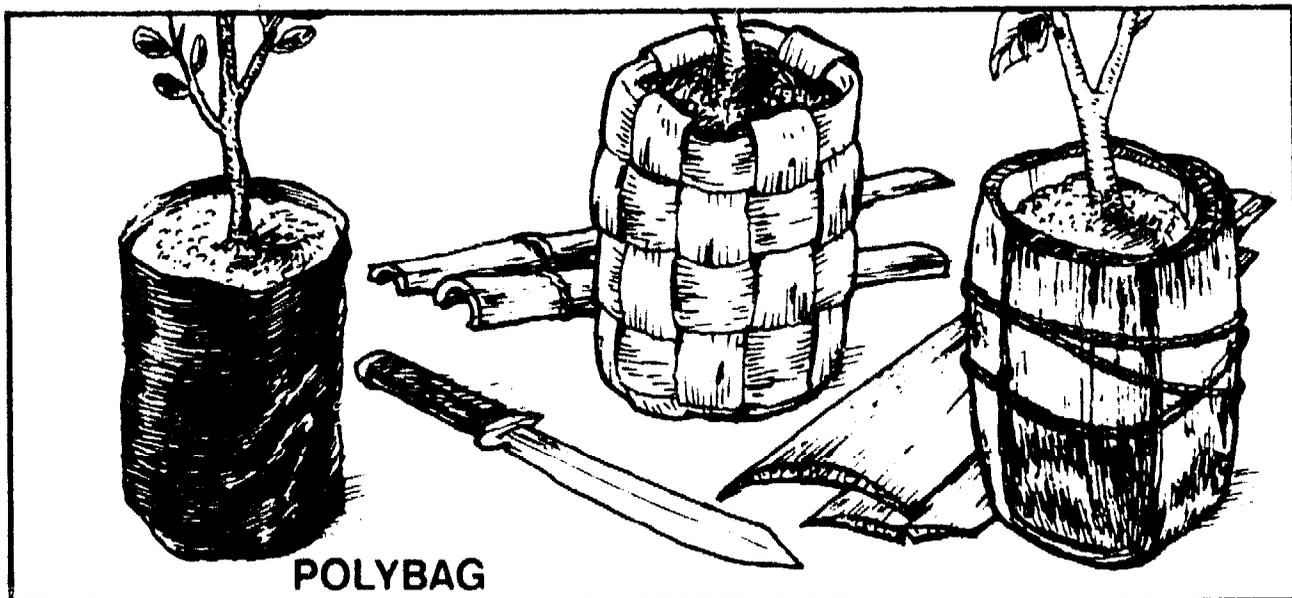
It is important to decide when the best time to begin the seedbed or nursery is. It is often best to begin during the early part of the dry season so that seedlings can grow as much as possible by the time the planting season begins.



The first step in setting up a nursery is finding a proper site. The best place is one that is easy to reach, close to a water source, sheltered, and protected from livestock. If necessary, a fence can be constructed to protect the nursery.

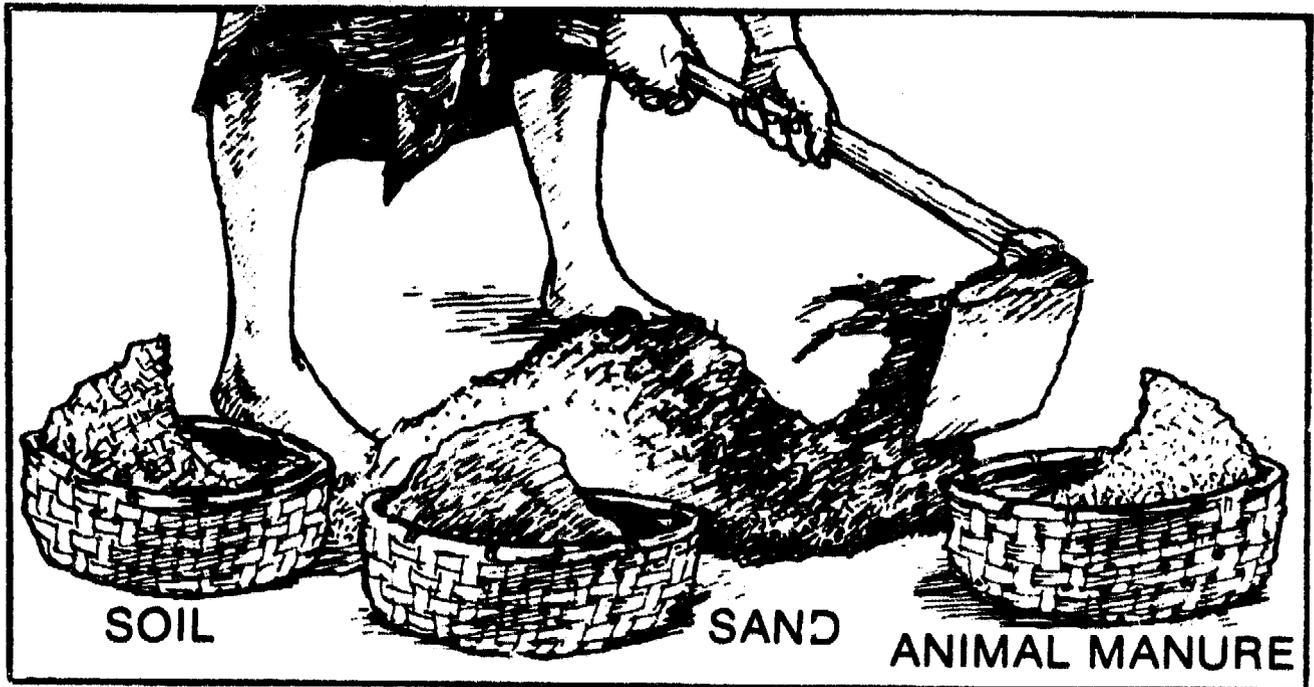


Plastic bags used in the nursery should have a diameter of 7 to 10 cm. These bags can be made by cutting a cheap roll of plastic into 20 cm. pieces and sealing one of the ends. After adding soil, holes must be punched in the bag so that excess water can drain out.



POLYBAG

For tree species that need to remain in the bags for six months or more, bags might be obtained from program personnel, government agricultural offices, or agricultural supply stores. If polybags are not available, containers can be made from banana stems or bamboo. While these will not last as long as polybags, homemade containers are cheap and easy to make.



Soil used in seedbeds or nurseries must be fertile and loose enough that water can penetrate. Containers should be filled with a mixture of equal parts (1: 1: 1) of soil, manure, and sand (**not** beach sand). The soil, manure and sand must be mixed thoroughly before filling the containers.



Polybags should be filled to the top with the soil mixture so that the top of the bag does not fold down on top of the small plant and kill it.



Containers should be arranged neatly in the nursery rack and kept well-watered and weed-free. It is also important to keep the soil from becoming too packed by loosening it regularly.



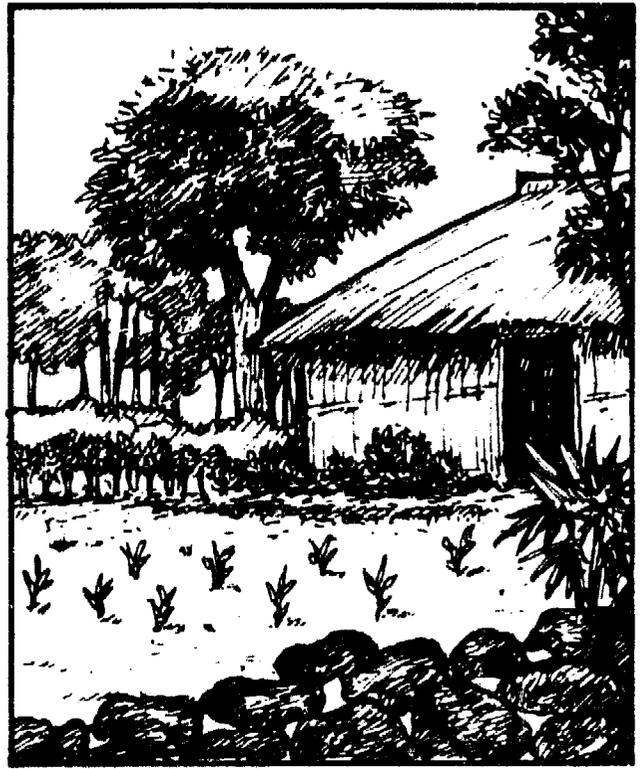
By placing the seedlings in a raised rack, they are both easier to take care of and protected from livestock. In addition, the roots that break through the plastic will not become rooted in the ground. The rack should be about waist-high and strong enough so that it does not collapse under the weight of the plants after watering.



When the plants are old enough to survive in the field, the seedlings can be moved out of the nursery. Transplanting usually takes place at the onset of the rainy season so that the seedlings do not need to be watered anymore.



CULTIVATED FIELD



FIELD NEAR THE HOUSE

SLOPING LAND



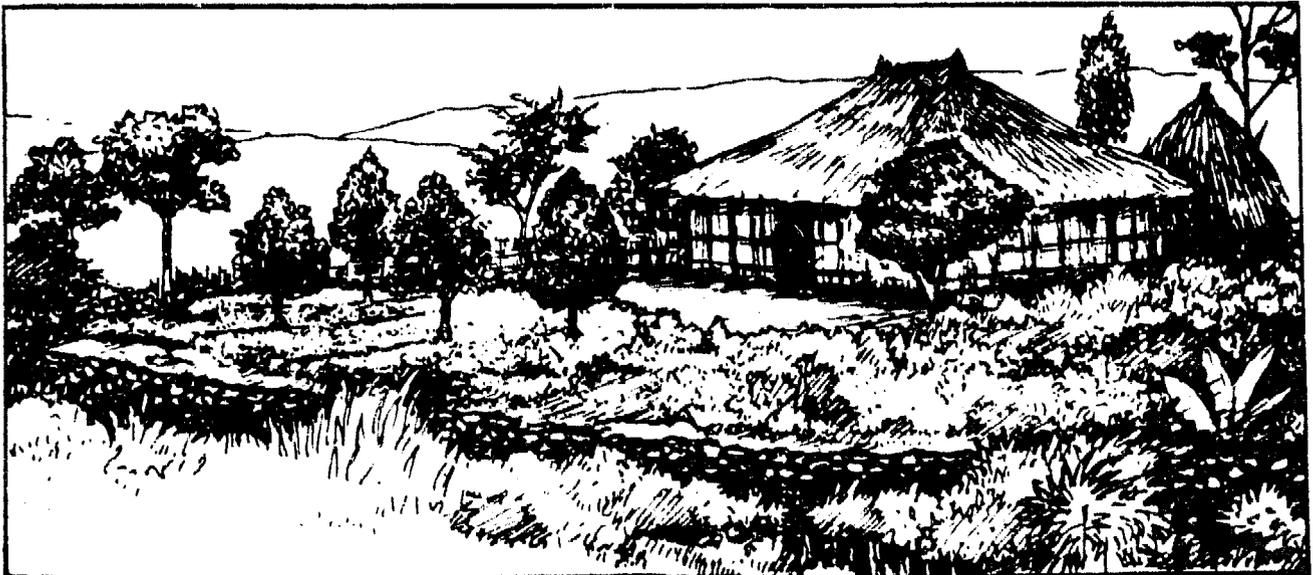
VERY DRY AREA



Careful consideration must be given to where to plant the seedlings before they are taken out of the nursery. The choice will depend upon the kind of tree to be planted, the type of field to be used, the nature of the soil, and the general environmental conditions of the area.



Plant spacing and soil depth are very important to consider. In general, trees do best when planted in a deep, friable soil so that there is room for the roots to grow and so that excess water can drain easily.



In order to simplify care of trees, and at the same time provide shade for the family, more valuable trees can be planted nearer to the house.



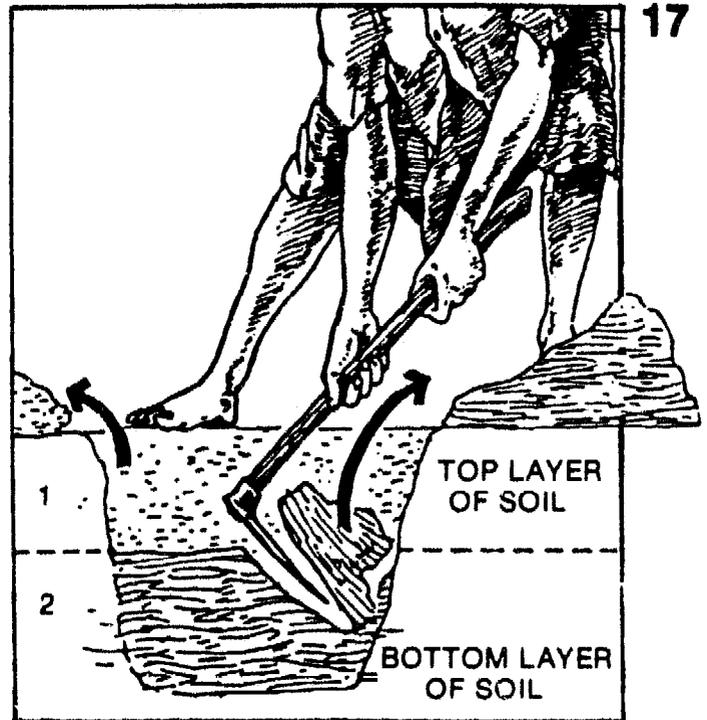
For sloping lands, soil conservation measures should be undertaken before trees are planted, in order to prevent the topsoil from washing away.



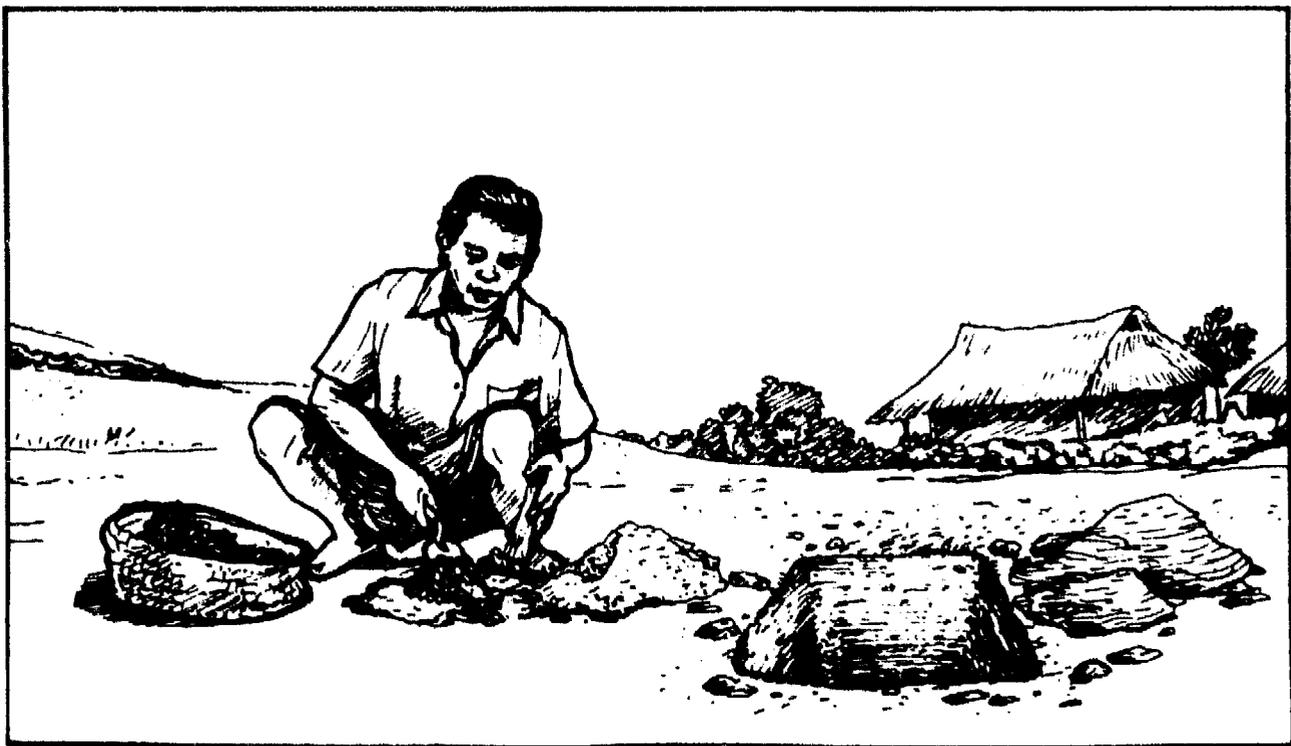
Very steep land should be completely planted to regreening species which can also be used for firewood. Such lands are often in poor condition and can be greatly improved through afforestation.



Seedlings being set out in the field or garden should be planted in a hole prepared **at least 2 weeks** before transplanting. The size of the hole should be 50-100 cm².



When digging the hole, care should be taken so that the top layer of soil is not mixed with the less fertile soil from the bottom of the hole.



The top layer of soil should be mixed with manure or compost and returned to the hole at the time the seedling is planted. The soil from the bottom of the hole should be discarded.



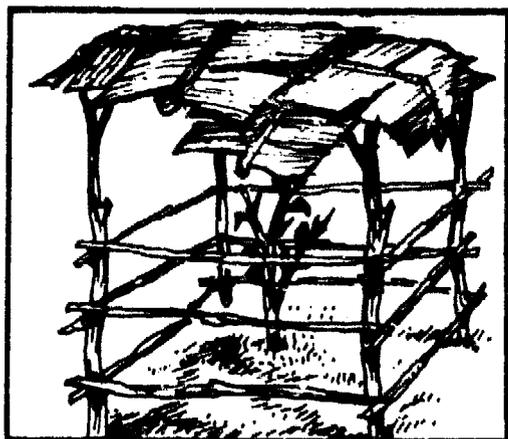
WET
CONDITIONS



DRY
CONDITIONS/
SANDY SOIL



Each seedling should be carefully removed from its container and planted so that it is even with the ground level around the hole which has been prepared. In dry, sandy soil, the seedling should be planted several centimeters below the level of the ground around the hole to help catch and retain rain water. After the tree seedling has been planted, the soil around the roots should be tamped down.



While newly planted seedlings are still weak, shade needs to be provided to protect them from direct sunlight. Certain kinds of trees like coffee, cloves, and cacao, can be planted with appropriate permanent shade trees. Permanent shade trees, (usually species of **Leucaena**, **Albizia**, **Gliricidia**, or **Erythrina**), must be prepared well in advance.



The newly transplanted seedlings should be watered regularly during the first few months, especially during dry periods. If livestock are not penned in the area, a fence should also be built around the young trees.



In areas that are dry or have sandy soil, dried plant materials can be used as a mulch in order to conserve soil moisture.



Plants generally grow better with additional nutrients. Trees can be fertilized with compost, animal manure, or chemical fertilizers if available.



These fertilizers are applied by spreading them in a circle around the trees.



Good growth in the initial stages will increase production in the long run and is well worth the time and cost involved in caring for the young trees.



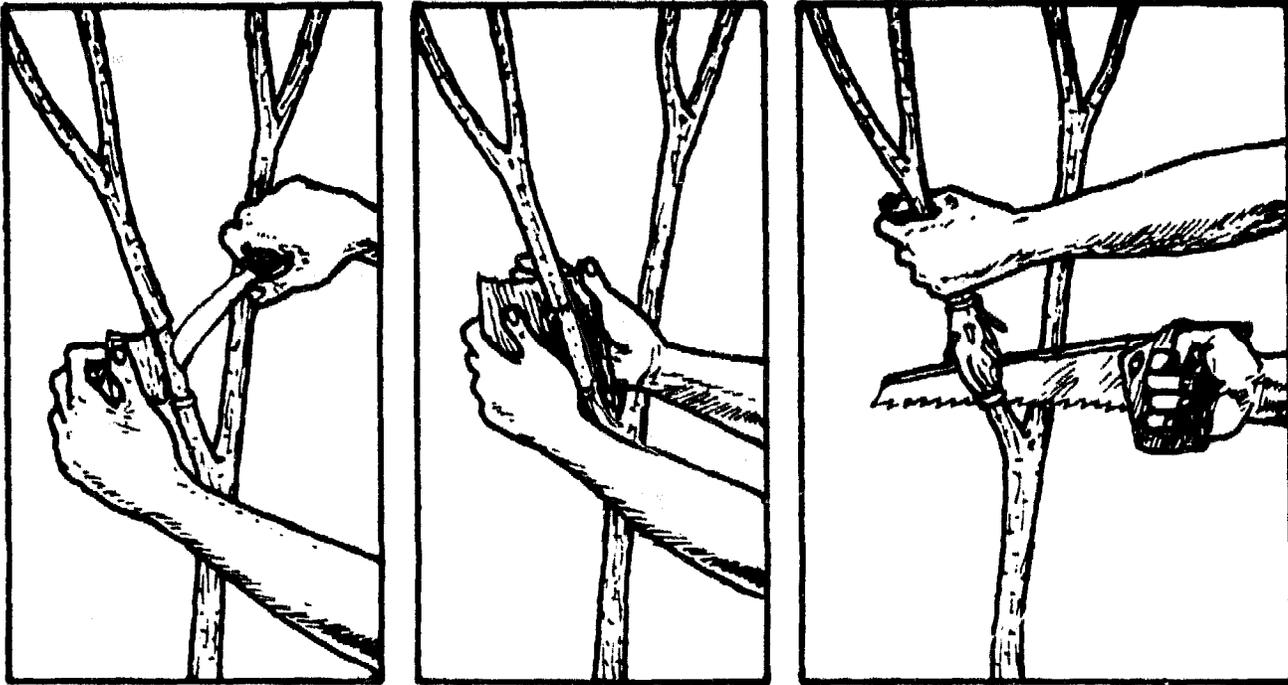
Proper pruning during the first year is important since trees begin to develop the proper shape to provide quality fruit at this time.



Branches that are broken, diseased, or harbor parasites should be removed as close as possible to a main branch. It is important to use a sharp tool such as a machete, saw, or pruning shears for pruning. Care must be taken to clean the tool after pruning sick trees so that the disease will not spread.



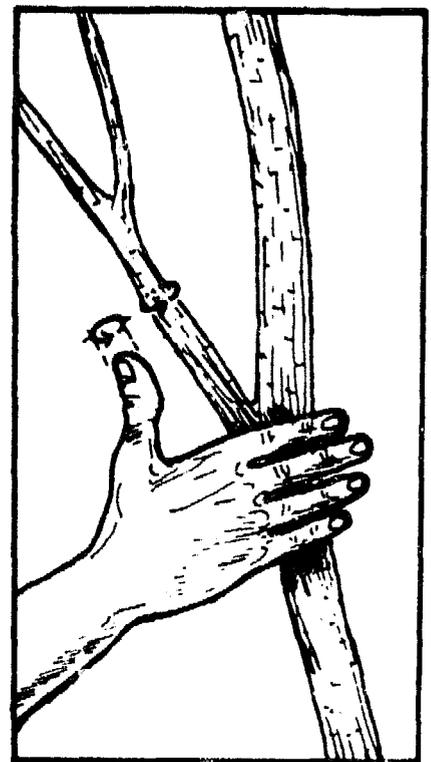
When a tree is growing well and producing high-quality fruit, it is time to think about the best way to reproduce it: Should it be grown from seed, "air-layered", or "grafted"?



“Air-layering” is a simple method of reproduction often used for fruit trees. First, the bark is peeled from a section of a branch of a healthy tree. The peeled section is then wrapped in moist material until new roots are formed. Finally, the branch is cut off and planted.



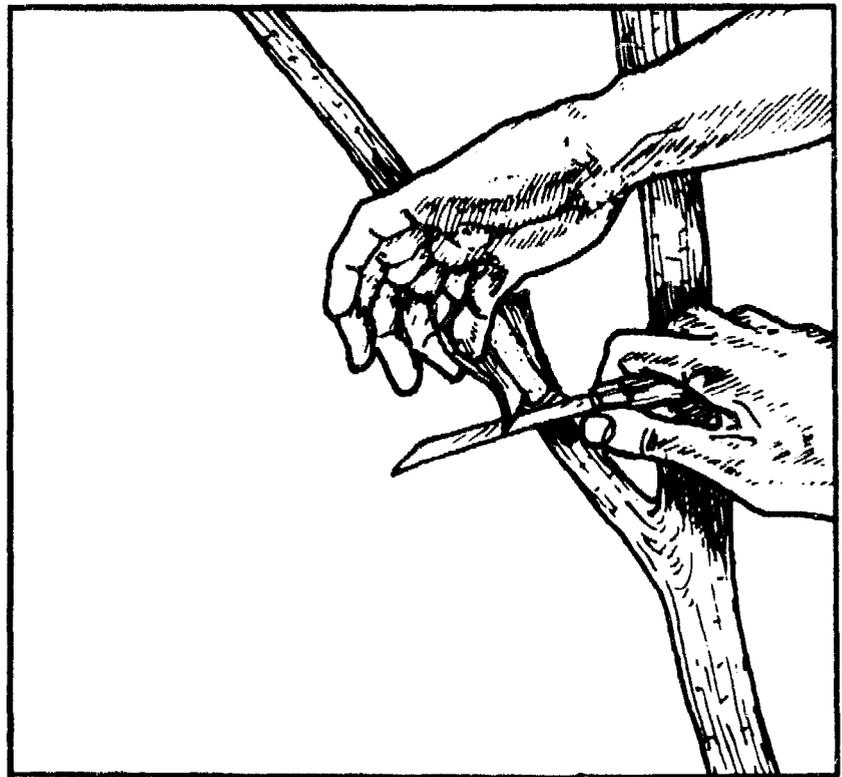
The advantages of this method are that the new tree will 1) have exactly the same qualities as the original tree and 2) begin bearing fruit in a shorter time than a tree grown from seed. Unfortunately, “air-layering” is rather slow, and is difficult to undertake on a large scale.



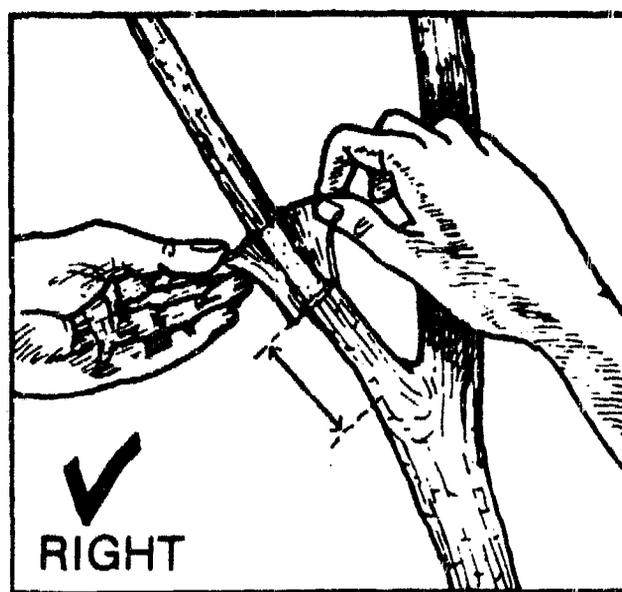
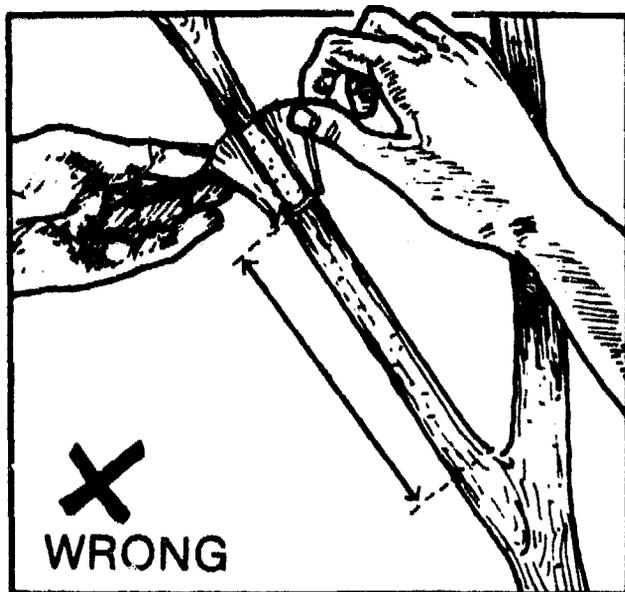
Air-layering can only be done on older trees (at least 1-2 years old) that are healthy, have branches with good growth, and have smaller branches the size of a pencil or thumb.



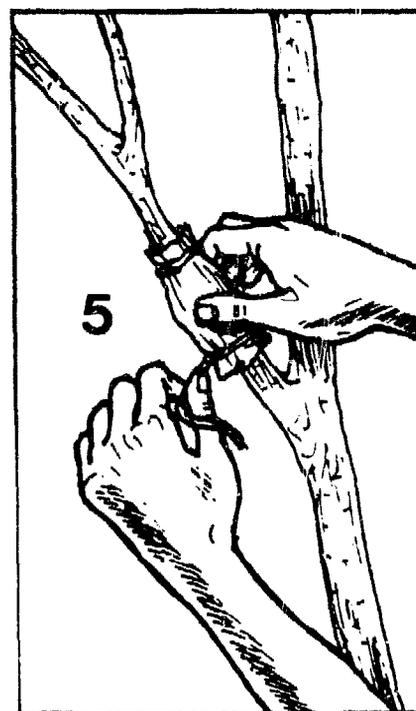
The length of the peeled section should be between 2 and 4 centimeters, or a little longer than the top part of a thumb.



Peel the bark completely (both outer and inner layers) using a sharp, newly cleaned knife.



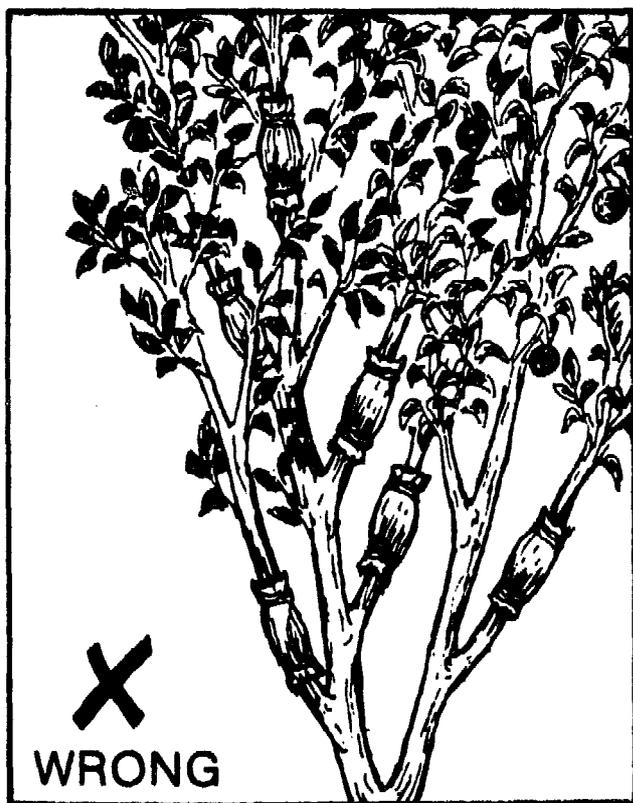
Air-layering should be carried out near a fork in the branch. This will result in better growth and help the new tree to root better after the branch has been cut and transplanted. The peeled section must be left open for three days before being packed with the moist material.



The peeled section of the branch to be air-layered should be packed with moist soil covered with the inner portion of a coconut husk (or other fibrous material) (1). First, wet the husk (2) and squeeze it out so that it is not too wet (3). Next, place the moist soil onto the husk (4), and wrap this around the branch to be air-layered. The packing is then bound with plastic so it is air- and water-tight (5). (Using transparent plastic will make it easier to check root growth).



Although it is better to air-layer trees in the rainy season, air-layering can also be done during the dry season if a dependable source of water is available so that the packing on the branch will not dry out.



For each tree, select only a few branches to be air-layered. If too many branches are used at the same time, the tree will become weak and grow poorly.



In about 30-100 days, the roots on the air-layered branch should have grown enough so that the plastic can be removed. It is not necessary to remove the husk/soil packing from the roots. The air-layered branch can then be cut off near to the fork in the branch and carefully transplanted into a container.





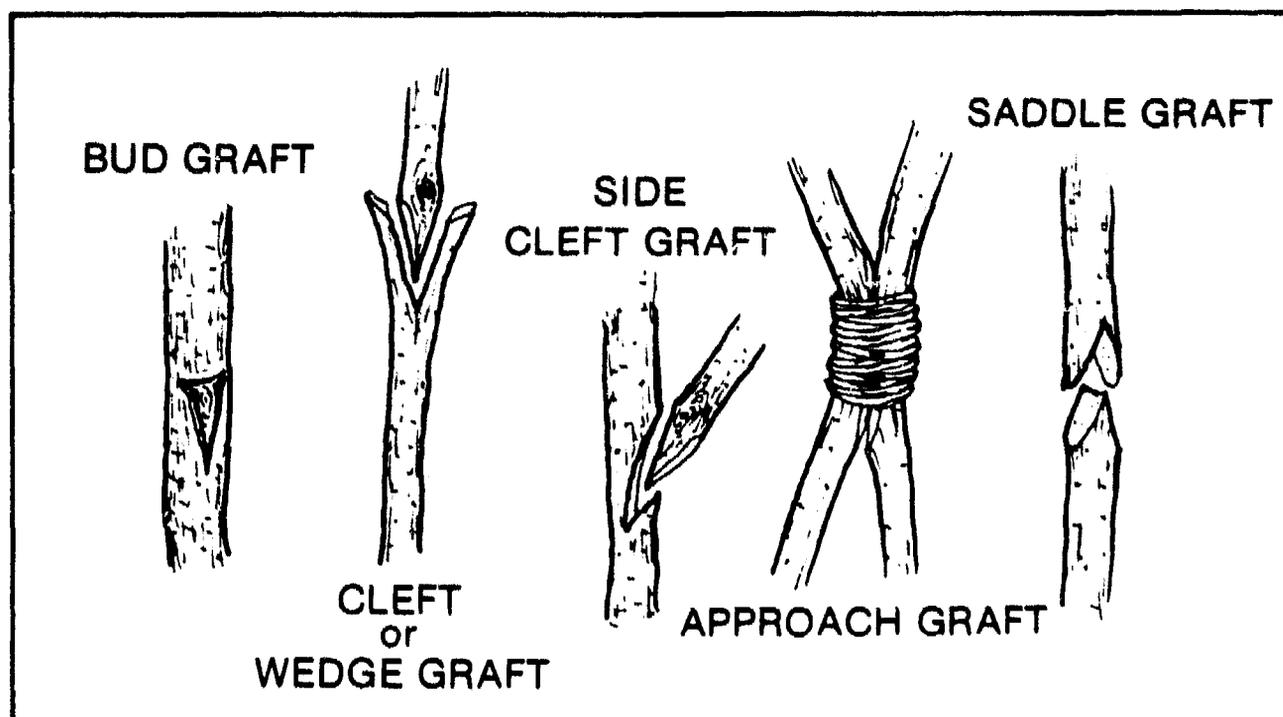
Grafting is a method of reproduction that can also improve tree quality. This is done by joining together parts of two different plants to make a new tree, which will have the good characteristics from each of the plants joined or "grafted". For example, characteristics such as high quality fruit, high yield potential, and disease resistance from one plant can be combined with the ability of a second plant to adapt to a certain type of climate.



Grafting is done by affixing a cutting from one plant onto a branch of another plant.



Grafting is not simple to learn: It requires a certain amount of precision, patience, and skill. Even so, a farmer who is both diligent and persistent can learn simple grafting techniques which do not require the use of specialized equipment. This section is intended as a guide to the basic techniques of grafting. However, there is no substitute for direct field experience and continued practice of these methods.



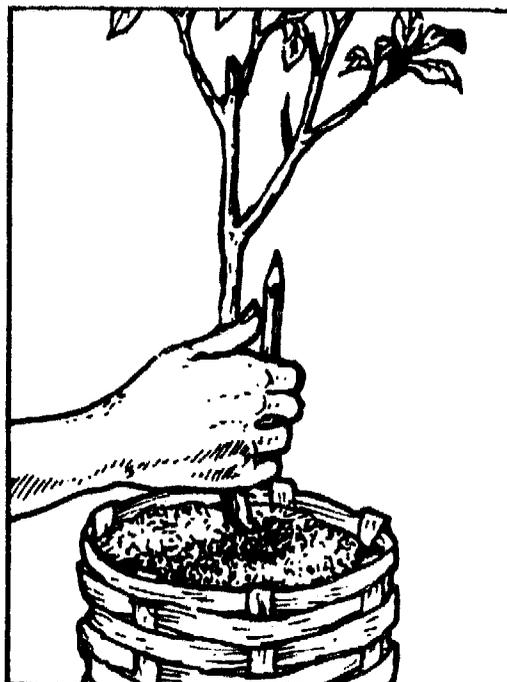
There are several ways to graft plants. These methods have different uses for different plants. Simple "budding" (making a "bud graft") is suggested for many plants because it is easy and precise.



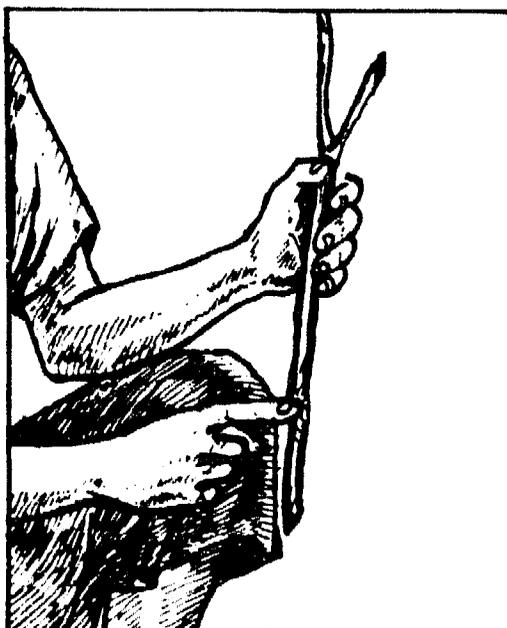
For bud grafting, a bud or group of buds (eye) is taken from a healthy tree and attached to a main branch or stem of another plant. The detached bud (or shoot) used for grafting is called the "scion". The tree to which the bud is attached or grafted is called the "stock".



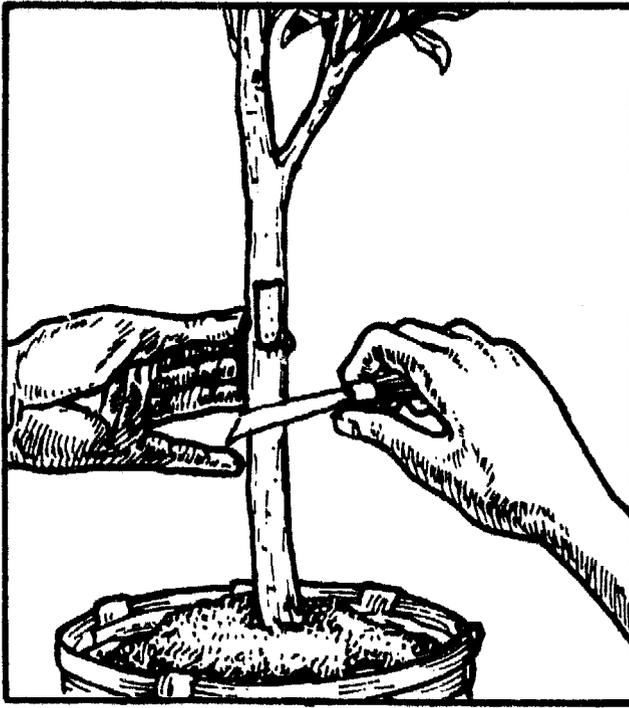
Stock plants should be planted in a container long before they are to be used. They should be strong, adapted to soil and climatic conditions where they are later to be planted, and resistant to major pests and diseases. Plants used as stock are generally grown from seed. The seed should not come from the the same tree as the scion or from other grafted trees.



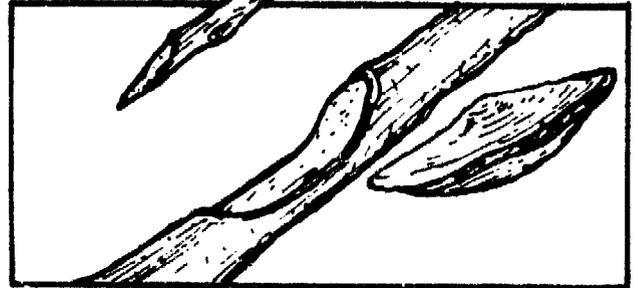
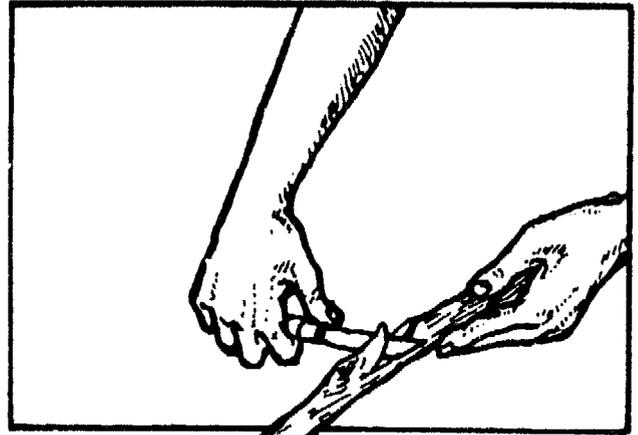
While the stock plant (onto which the buds or eyes will be grafted) can be used when only a few months old, it is generally better to wait until it is 8-12 months old and the stem has reached a diameter of around $\frac{1}{2}$ cm (about the size of a pencil). It is best to graft onto stock plants in the nursery since they can be better cared for there.



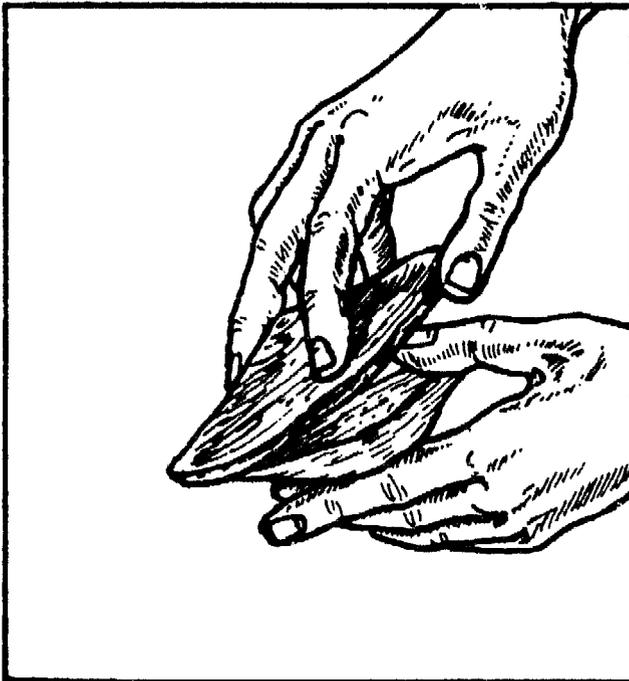
The bud (or eye) should be taken from a mature tree (at least 3 years old) which has already proven to give good quality fruit. The bud should be taken from a woody branch approximately the same size as the stock stem on which it will be grafted. The branch from which the bud will be taken should first be cut to a length of about 20-30 cm.



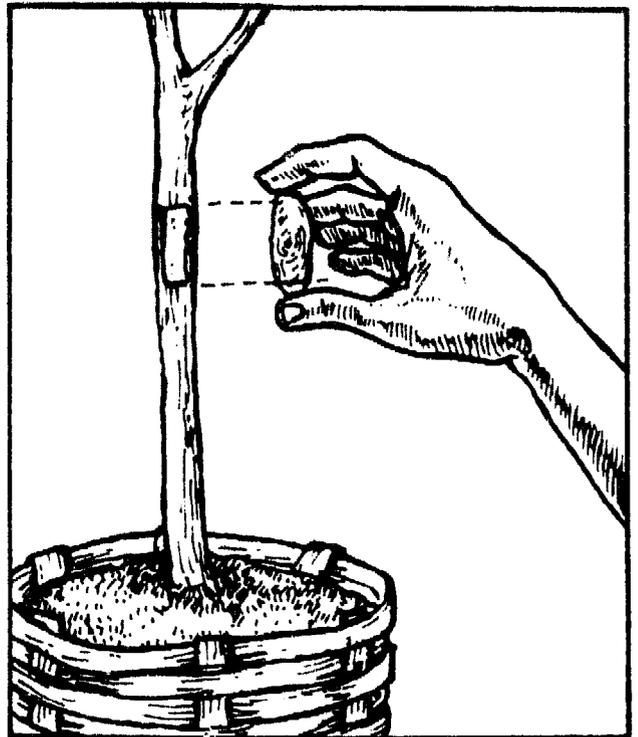
Using a sharp, clean knife, a small section of the stem of the stock plant is peeled near the base. Care should be taken not to wound the wood beneath the bark.



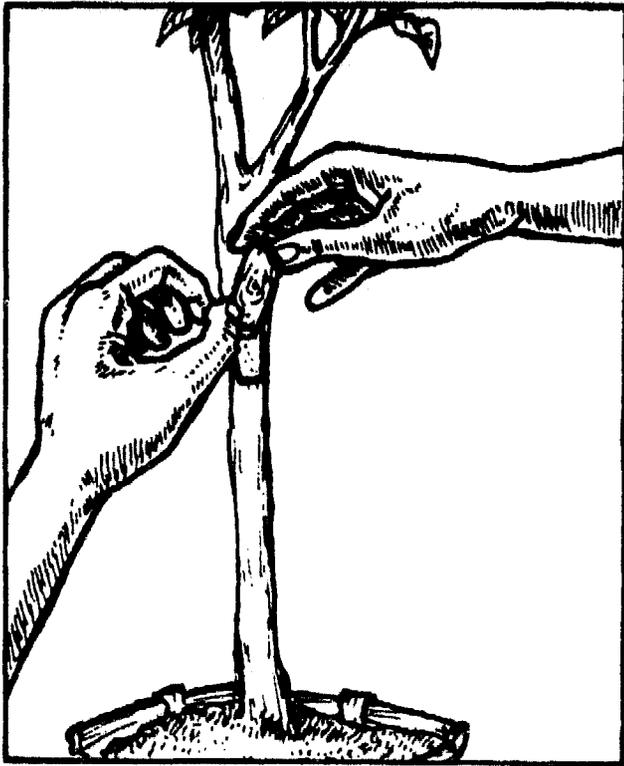
The bud is separated from the scion with a single slicing cut that includes some of the wood beneath the bark.



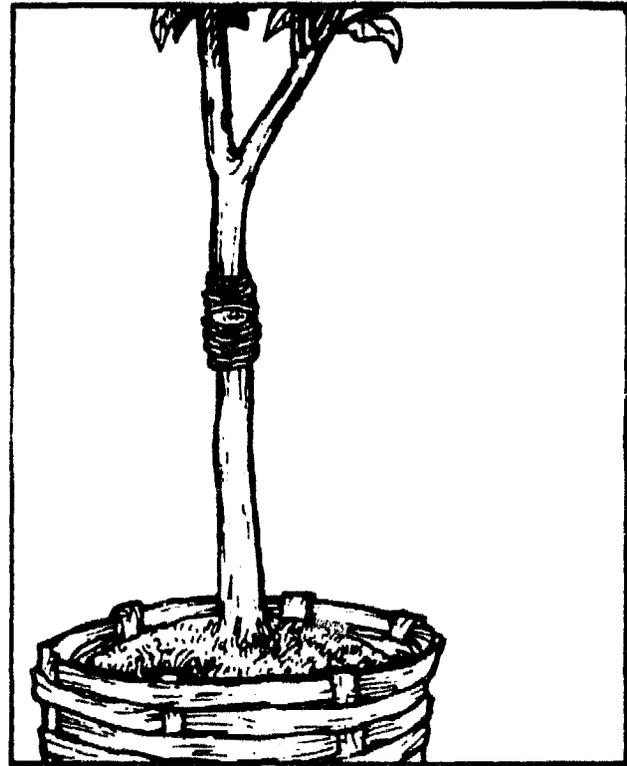
The bud (together with the bark) is then carefully peeled off the piece of wood beneath the bark, without wounding the bud itself.



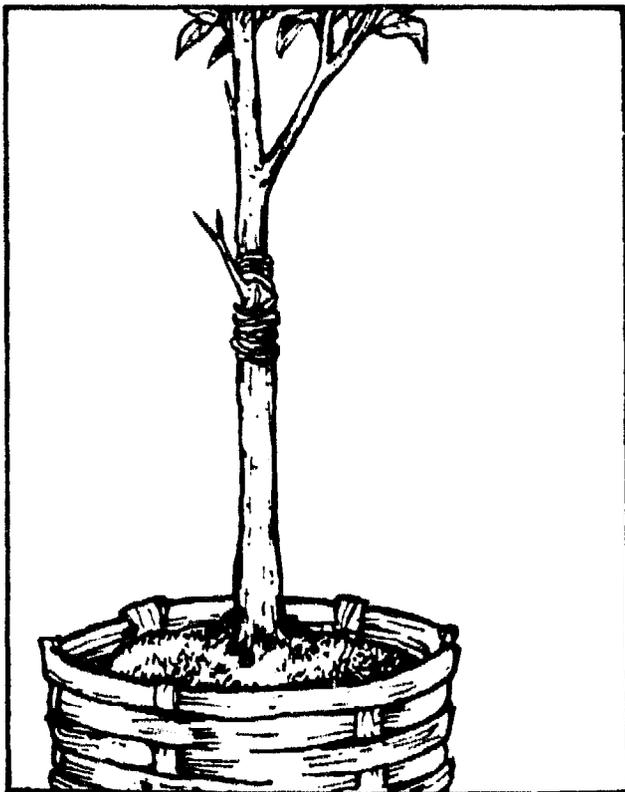
The bud must be about the same size as the area already peeled off the stock plant so that the bud can be joined with the stock precisely.



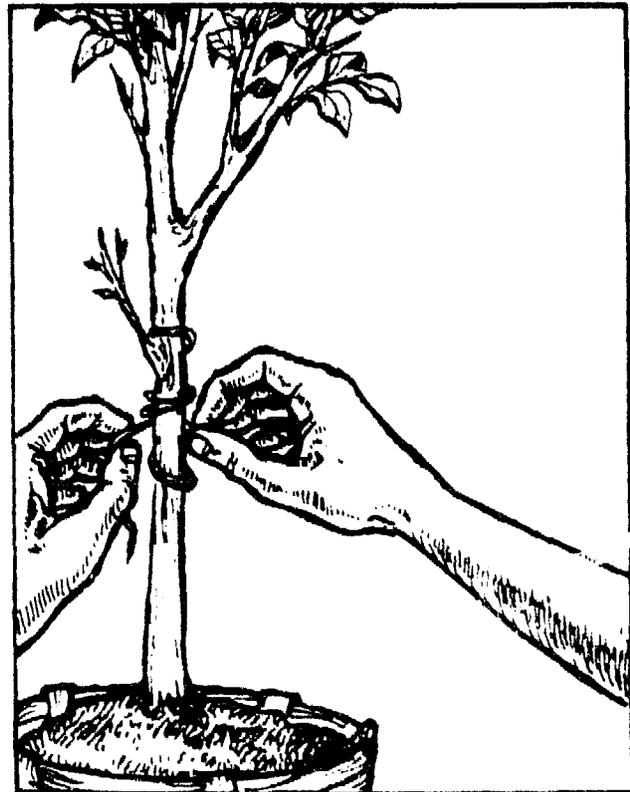
Attach the prepared bud to the peeled area of the stock, being very careful not to damage it.



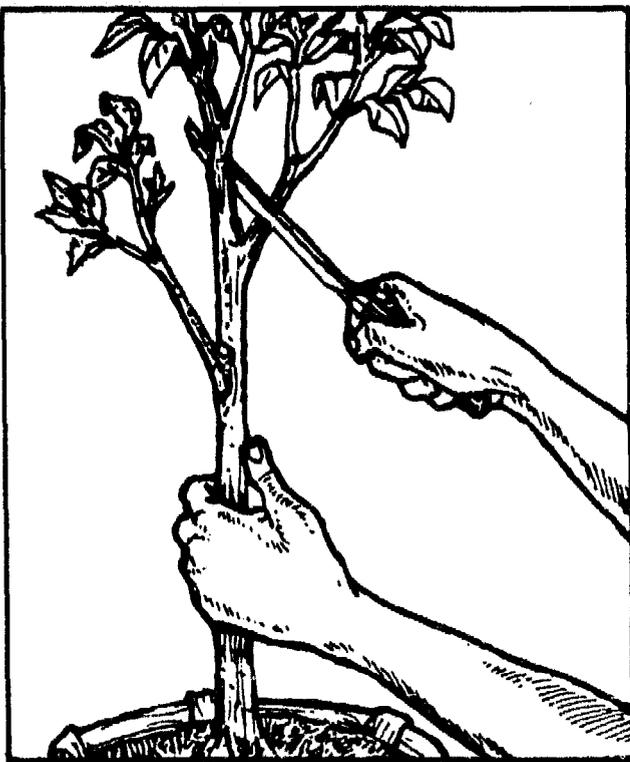
Using tape or plastic twine, bind the area around the newly-attached bud so that only its tip is visible.



After 2-3 weeks, the attached bud should still be moist, green, and growing.



After the bud begins to grow on the stock plant, the twine should be removed.



When the bud shows good growth, all branches above and below the grafted bud should be cut halfway through and left hanging limp. If the growth of the grafted bud remains good, these cut branches can be removed completely with a sharp knife. If necessary, the newly-growing branch should be provided with some type of support.



When the new tree is growing well, it can be moved from the nursery to a permanent place. The grafted tree should be transplanted and cared for as described on pages 17-20.



Who wouldn't be pleased if they could provide a long term, dependable source of fruit, animal forage, firewood, and income for their family! This can certainly be achieved with good planning, some hard work, and proper care of the trees we plant.

APPENDIX 1 Worksheet

Name _____
 Neighborhood _____
 Village _____
 District _____

Field Conditions

Elevation above sea level _____ meter.

Local field conditions: _____
 (Hilly/ Steep/ Sloping/ Slightly sloping/ Flat)

Soil type: _____
 (Clay/ Clay loam/ Loamy/ Sandy loam/ Very sandy)

Soil depth: _____
 (Shallow/ Average/ Deep) _____ cm.

Land ownership: _____
 (Owned/ Rented/ Sharecropped/ Owned by relatives)

Area of available land: _____ ha.

Wood

SOURCE OF FIREWOOD

Gathered at _____ Bought at _____
 Distance from house _____ Price _____
 Time required for gathering _____ hours
 Time of day gathered (morning/ midday/ afternoon)
 How often gathered _____ times every (day/ week)
 Amount needed every week _____ bundles
 Types of trees used _____,
 _____,

SOURCE OF LUMBER/ OTHER WOOD FOR BUILDING

For building _____,
 Collected by self at _____ Bought at _____
 Distance from house _____ Price _____
 Time required _____ hours
 When collected (Dry season, Wet season)
 Amount needed _____ (Trees/ Boards/ Cubic meters)
 Kind of trees usually used _____

Cash Crops

Types of Cash Crops Locally Bought and Sold

Type of Tree	Yield/ Amount	Amount Bought/ Sold	Price	When Harvested
--------------	---------------	---------------------	-------	----------------

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Where Bought/ Sold _____
Distance from village _____

What kind of tree is appropriate to plant in the area?

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Souce of seed/ seedlings _____

Table I Fruit Trees

Name of Tree	Elev.(m.)	Method of Reproduction	Planting Distance (m.)	Ability to Withstand Dry Conditions	Notes
Avocado	0-1500	S/AL/GR	14-16	Good	
Apple		S/SU/AL/GR			
Tamarind	0-1000	S/AL/GR	15	Good	
Carambola	0-500	S/AL/GR	6	Good	
Java Plum	0-500	S/AL/GR	12	Good	Needs Dry Season
Durian	0-800	S/GR	14	Not Good	
Watery Rose Apple (<i>Syzygium aqueum</i>)	0-1000	S/AL/GR	6-8	Good	
Guava	0-1000	S/AL/GR	6-8	Good	
Pomelo	0-600	S/AL/GR	10-14	Good	
Sweet Orange (<i>Citrus aurantiola</i>)	0-1000	S/GR	6-8	Very Good	
Sour Lime (<i>Citrus aurantifolia</i>)	0-1000	S/AL/GR	6	Good	
Kedondong (<i>Spondias pinnata</i>)	0-700	S/GR/ST	8-10 x 12	Good	
Litchi	+ 1000	S	10	Not Good	
Mango	0-500	S/AL/GR	12-14	Good	Needs Dry Season
Mangosteen	0-800	S	10	Good	
Jackfruit	0-1000	S/GR	12	Good	
Papaya	0-1000	S/GR	2-5	Very Good	
Rambutan	0-600	S/AL/GR	12-14	Not Good	
Snakefruit (Salak)	0-500	S/SU	3-5	Good	
Star Appie	0-300	S/AL/GR	12	Good	
Sapodilla (<i>Manilkara kauki</i>)	0-300	S	12	Good	
Soursop	0-1000	S/GR	5-7	Good	
Custard Apple	0-800	S/AL/GR	6	Good	Needs Dry Season

S=Seed
AL=Air-layering

GR=Grafting
SU=Sucker

Table II
List of Regreening Trees

Name	Elev.(m)	Reproduction	Use	Notes
<i>Acacia auriculiformis</i>	0-600	Seed	F/Ch	Tolerates long dry season
<i>Albizia falcataria</i>	0-1500	Seed	F/Ch	
<i>Eucalyptus deglupta</i>	0-2000	Seed	F/W	Tolerates long dry season; must be raised in seedbed
<i>Casuarina equisetifolia</i>	0-2000	Seed/sucker	F/Ch	Tolerates long dry season; Can be grown in various soil types
<i>Erythrina</i> spp.		Seed/Stake	F/LF/S	
Madre de Cacao (<i>Gliricidia sepium</i>)	0-1000	Seed/Stake	F/LF/S/Fo	
Teak	0-600	Seed	L	Tolerates long dry season
<i>Cassia siamea</i>	0-1000	Seed	F/Ch	
Calliandra (<i>C. calothyrsus</i>)	0-1750	Seed	F/Ch	
<i>Schleichera oleosa</i>	0-600	Seed/sucker	F/Ch	
Leucaena	0-1000	Seed	F/Ch/Fo	Susceptible to jumping plant lice damage
Mahogany	0-1000	Seed	L	
Saga (<i>Adenanthera microsperma</i>)	0-800	Seed	F/Ch/W	Tolerates long dry season
Rosewood (<i>Dalbergia latifolia</i>)	0-1000	Seed/?	L	Tolerates long dry season

F=Firewood
LF=Living fence
Ch=Charcoal
S=Shade for estate crops

W=Wood for building
L=Lumber (Class I)
Fo=Forage

Table III
Estate Crops

Plant Name	Elev. (m)	Method of Reproduction	Length in Nursery	Planting Distance
Cacao	0-500	Seed	6-8 months	5 x 5 m
Cloves	300-1000	Seed	12-24 months	8 x 8 m
Cashew	0-1200	Seed	8-10 months	10 x 10 m
Castor bean	0-2000	Seed		1 x 0.3 m
Coconut	0-700	Seed	1-2 months	9 x 9 m
Coffee (Robusta)	350-1000	Seed	9-10 months	2.5 x 2.5 m
Coffee (Arabica)	1000-1700	Seed	9-10 months	2.5 x 2.5 m
Black Pepper	0-1000	Stake		1.5 x 1.5 m
Ramie/ Sisal	0-250	Sucker		1 x 1.5 m
Vanilla	400-700	Cutting		1.25 x 1.5 m