

## LEARNING FACILITATING MATERIALS

### NATIONAL CERTIFICATE LEVEL 1

### TRADE AREA: **CASHEW PRODUCTION**

#### UNIT 5

## **CANOPY SUBSTITUTION IN A CASHEW PLANTATION**





This publication has been produced with the assistance of the Ghana Skills Development Initiative (GSDI) III, a project implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in cooperation with the Council for Technical and Vocational Education and Training (COTVET) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), co-funded by the European Union (EU) and the Swiss State Secretariat for Economic Affairs (SECO). The contents of this publication are the sole responsibility of GIZ and COTVET and can in no way be taken to reflect the views of the stakeholders.



## UNIT INTRODUCTION

Welcome to Unit 5 of your learning journey in cashew production. This guide explains the main steps for canopy substitution in cashew plantations.

Do you already know that canopy substitution is an important Good Agricultural Practice (GAP) for rejuvenating old cashew farms?

If you follow the steps for canopy substitution in the right sequence, you can successfully improve yields of cashew trees that are between 15 and 25 years old, but do not produce well. Do not miss a step! Apply your knowledge and skills perfectly to increase yields in your old cashew plantation.



In this unit, you will learn about the main steps for canopy substitution in cashew plantations. The learning material covers five sub-units:

- 1) Canopy substitution
- 2) Cutting cashew trees for canopy substitution
- 3) Harvesting cashew scions for canopy substitution
- 4) Grafting for canopy substitution
- 5) Nurturing grafted plants

Each sub-unit contains theoretical and practical exercises. Each module includes written materials, visuals as well as self-assessments to test your knowledge and skills.

Follow the recommended Good Agricultural Practices (GAP) for canopy substitution and use scions from high-performing mother trees to increase the yields and quality of your cashew fruits.

Scientific research on model farms, the exchange of knowledge with experts worldwide as well as field observations have shown that the application of GAPs improves quality and quantity of yields by about 30 %. The use of improved planting materials has tripled and, in some cases, quadrupled cashew productivity in West Africa.

Even though this learning material provides essential information on canopy substitution in cashew plantations for National Certificate Level 1, you should also look out for new information, innovations and technological advances during your practical work that expand your knowledge and skills.

Do you want to become an expert in cashew? This is your chance!

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## ICONS



LEARNING  
OBJECTIVES



ATTENTION



PRACTICALS  
HANDS ON



CROPPING  
CALENDAR



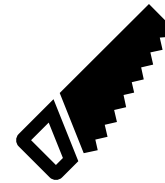
SELF ASSESSMENT



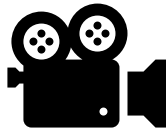
WELL DONE!



TAKE A BREAK!



DEMONSTRATE  
USE OF  
TOOLS



WATCH VIDEO

## ABBREVIATIONS

Here are some commonly used abbreviations.

°	Degree ( <i>Angle</i> )
cm	Centimetre ( <i>1 cm = 10 millimetre</i> )
GAP	Good Agricultural Practices
m	Meter ( <i>1 m = 100 cm</i> )
ml	Millilitres ( <i>1000 ml = 1 litre</i> )
PPE	Personal Protective Equipment
ROI	Return on Investment

## 1. DEMONSTRATE KNOWLEDGE OF CANOPY SUBSTITUTION IN CASHEW PLANTATION

### a) Explain canopy substitution

Top-working or canopy substitution is the replacement of the crown of an underperforming (low-yielding) tree by grafting scions with desirable characteristics from elite mother trees on them. The purpose is to improve the productivity of the tree by taking advantage of its already well-developed root system.

Canopy substitution is done to rejuvenate cashew plantations without planting new seedlings.

The advantages of top-working are:

- Rapid tree growth
- Quick return on investment (ROI)
  - Production can start 1 - 2 years after top-working
- Improvement of yields of the grafted tree



Source: Yeboah (2018) – Established top-worked tree



Canopy substitution takes place from April to June.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

## b) State the importance of canopy substitution

Top-working is an important method used to raise the productivity of old and unproductive trees. In order to reap the benefits of top-working, it is necessary to stump and graft all underperforming trees with scion from trees of proven high performances or clones.

Canopy substitution becomes necessary when:

- the fruits (apple and nuts) produced by the tree are of poor quality
- you want to introduce a new variety on the same tree to increase the size or processing outturn of the kernel
- the tree is unproductive with low yields even after the use of growth regulators
- the tree was burnt by fire or affected by heat from burning fire
- the architecture of the tree is not uniform (e.g. when the canopy is very wide and laying down)

## c) Identify trees for canopy substitution

Cashew trees selected for top-working must:

- be low yielding (less than 6 – 8 kg of nuts / tree / year)
- bear small size nuts (less than 7g / nut) or both
- ideally be under 15 years
- be in condition of active growth
- be healthy (e.g. the stem must be free of major infestations, in particular stem borer)



Inspect the cashew plantation during 2 - 3 seasons to be sure on the poor performance of each tree.



Consult the farmer and the women who are involved in harvest operations, before taking a decision on cutting down trees for top-working.



Identify and mark the trees that meet the selection criteria for top-working.

d) **State the equipment and materials used in canopy substitution**

The following equipment is required for canopy substitution:

- **Chain Saws** are used for cutting trees and stumps.



Caution! Only use a chain saw after you have been trained on the use and maintenance of a chain saw. Find a chain saw operator to help you with tree cutting.



Use **Protective Glasses or Face Shield, Safety Helmet, Hearing Protection, Chain Saw Chaps and Gloves** when operating a chain saw.

Source: <https://www.murdochs.com/products/power-equipment/saws/heavy-duty-chainsaws/>

- Use a manual **Tree Saw** for cutting trees, branches and stumps.



Source: <https://www.obi.at/handsaegen-feilen/lux-baumsaege-holz-350-mm-classic/p/3028891>



The following materials are required for grafting in canopy substitution:

- A very sharp **Knife** for rootstock preparation
  - You need a sharp knife to make precise cuts
  - Sharpen your knife until you can slice a piece of paper with it easily, that means it is sharp enough
- **Polythene graft tape** to join your scion and rootstock together
- **Poly caps** to protect the grafts from drying
- **Cotton** to clean the tools with **disinfectant** before and after grafting
- **Scions** that are not older than 3 days
- Use very sharp **Secateurs** to cut the stem of the rootstock



Source: GIZ/ComCashew – Grafting materials



Using unclean grafting materials can lead to contamination and infection of the rootstock and/or the scion. Always keep your grafting materials clean!

**e) State the factors to consider in canopy substitution**

The success rates of canopy substitution are much higher in plantations up to 15 years and with trees that have up to 1.1 meters of trunk perimeter. From 16 - 25 years, the percentage of top-working success gradually decreases. With trees more than 25 years, graft loss and operating costs increase.



Make a cost – benefit analysis of the entire process as the basis for your decision to conduct canopy substitution. Add all costs for top-working (labour, materials, tools, production loss of 1 - 2 years) against to potential gains of improved yields over a certain period of time.

Plan and implement canopy substitution of unproductive trees gradually. Depending on your farm size, divide the farm into 2, 3 or 4 plots and proceed with the rehabilitation in 2, 3 or 4 years. Gradual rehabilitation helps to compensate for yield loss before the recovery of cut and grafted trees.



## SELF ASSESSMENT

1. Explain canopy substitution.

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2. State the importance of canopy substitution.

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3. Identify trees for canopy substitution.

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4. State the factors to consider in canopy substitution.

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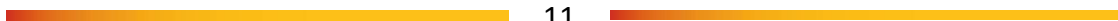
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*Congratulations! You have completed the first set of questions.  
Take a break before you move to the next chapter.*



## 2. DEMONSTRATE SKILLS IN CUTTING CASHEW TREES FOR CANOPY SUBSTITUTION IN CASHEW PLANTATION

### a) Explain cutting of cashew trees for canopy substitution

Cutting cashew trees for canopy substitution is also known as stumping. The cut is done 50 cm above the ground level and at an angle of 20° - 30°.

**Stumped cashew tree**



**Painted stump with kerosene and coal powder**



Source: Yeboah (2018) – Stumped cashew tree for top-working



For more information on stumping, watch video on *Thinning and Pruning a Cashew Groove – Peace Corps*. from Minute 3:11 to 7:27



Stumping is done after the harvest season in April and May.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

**b) State the importance of cutting cashew trees for canopy substitution**

It is important to cut the tree to initiate new shoots for grafting. Cutting at an angle of 20° - 30° is important to ensure that water does not collect on the cut surface.



Remember! In top-working you want to benefit from the already established root system of the tree. New shoots from the stump facilitate grafting of higher performing varieties on the stump.

**c) State the factors to consider in cutting cashew trees for canopy substitution**

Consider the following factors in cutting cashew trees:

- Select the right trees
- Use suitable tools for cutting, preferably a chainsaw
- Properly time the cutting period with the rainy season
- Make sure the cutting height is 50 cm above the ground
- The cutting angle should be 20° - 30°
- Protect the stump against drying and pest attack
- The stump must be covered with cashew leaves and branches from the cut tree to facilitate the initiation of new shoots for grafting

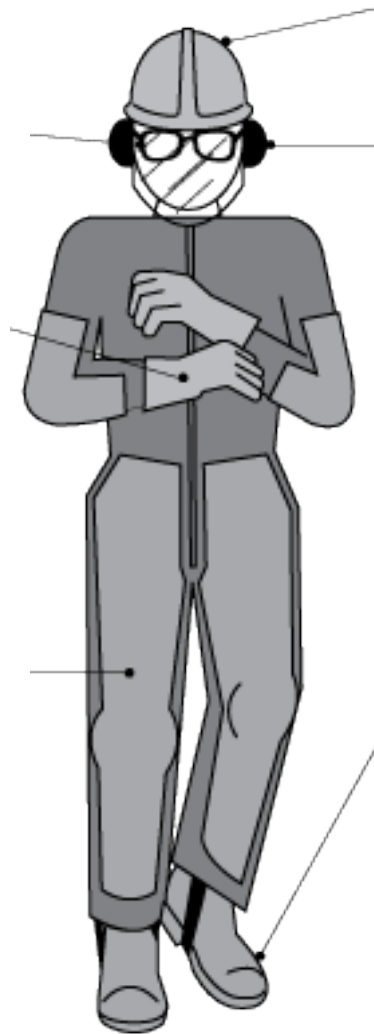
**d) Use Personal Protective Equipment (PPE) in cutting cashew trees for canopy substitution**

The Personal Protective Equipment is required in cutting cashew trees:

**Eye protection**  
Safety glasses,  
safety face shield.

**Gloves**  
Leather gloves with  
nylon reinforcement  
offer good grip and  
absorb vibration.

**Leg protection**  
Fitting trousers or chaps  
with nylon  
reinforcement from  
woven fabric.



**Head protection**  
Hard cover hat with a visible  
colour such as yellow, orange  
or red.

**Hearing protection**  
Chain saws create high noise  
levels of 95 – 115 decibels.

**Foot protection**  
Heavy, well-fitted work  
boots made of ballistic  
nylon with rubber soles.

Source: [https://www.ccohs.ca/oshanswers/safety\\_haz/chainsaws/pppe.html](https://www.ccohs.ca/oshanswers/safety_haz/chainsaws/pppe.html)

**e) Outline the procedure for cutting cashew trees for canopy substitution**

Use the checklist to follow steps 1 to 8 in cutting cashew trees for canopy substitution. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Activities	Rate
1. Select the right trees for canopy substitution	
2. Cut the tree at a height of 50 cm above the ground	
3. Paint the cut surface with a solution made of a mixture of kerosene and coal powder, or tar or drained oil to prevent the cut surface from drying out and insect attack.	
4. The cut surface can also be covered with lime (calcium bicarbonate)	
5. Cover the stump with branches and leaves from the cut cashew tree to facilitate the initiation of new shoots and <ul style="list-style-type: none"> <li>• to prevent drying up of the cut surface</li> <li>• to facilitate proper sealing of the bark</li> <li>• to promote sprouting of shoots</li> </ul>	
6. Inspect the stump regularly to ensure that shade is maintained for 21 - 28 days for good shoot initiation and development	
7. Remove the shade after 21 - 28 days when signs of new shoot initiation are evident	
8. Graft within 45 - 60 days after stumping when shoots are ready	

*Everything that you need to accomplish your goals is already in you.*

**f) Cut cashew trees for canopy substitution in cashew plantation**



Practical Exercise: Go to the farm for your apprenticeship and cut cashew trees with the tools that are available to you. Apply the knowledge that you have already gained from this section.



**SELF ASSESSMENT**

1. Explain cutting of cashew trees for canopy substitution.

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2. State the factors to consider in cutting of cashew trees for canopy substitution.

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3. Describe the required Personal Protective Equipment (PPE) in cutting of cashew trees for canopy substitution.

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*Well done! You are doing great on your path to success.*



### 3. DEMONSTRATE SKILLS IN HARVESTING CASHEW SCIONS FOR CANOPY SUBSTITUTION IN CASHEW PLANTATION

#### a) Explain cashew scions for canopy substitution

A scion is a young shoot or twig of a cashew tree that was especially cut for grafting. The scion normally has one or more newly-sprouted buds, that are leaves or blossoms that have not yet unfolded.



Source: Yeboah (2018) – Cashew scions



For more information on selecting scions, watch video on *Cashew Nursery Establishment and Grafting – Peace Corps Ghana* from Minute 4:22 to 5:46.



Harvesting of scions is done 45 - 60 days after stumping.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

#### b) State the importance of cashew scion selection for canopy substitution

The quality of the scion determines the quality of the entire plant. Therefore, scions have to be selected from mother trees with desirable characteristics or from a scion bank (clonal garden) for grafting.



Remember! Mother trees are highly-productive trees that generate quality yields.

Select the scions from mother trees to determine the quality of your cashew tree:

- If you choose a scion from a cashew tree that is highly productive and generates quality yields, your grafted shoots will have the same characteristics.
- If you choose a scion from just any tree (not a mother tree) your grafted shoots might not perform well and may generate low yields.

**c) State the factors to consider in selecting cashew scions for canopy substitution**

A good scion for grafting should have the following characteristics:

- Thickness of a pencil / the thickness should match that of the developing shoot
- Straight and between 12 - 15 cm long
- Greenish brown in colour
- A uniform colour
- Ripe with a swollen terminal bud
- Clean and free from diseases and pests

The following steps should be followed in preparing scions for grafting:

- Pre-condition the scions by removing the leaves 4 - 7 days before harvesting, preferably with secateurs or pruning shears
- Harvest the scions in the morning or evening
- Harvest the scions on the day of grafting



However, if for any reason the scions cannot be used on the same day, keep them in a wet cotton, jute bag or paper for up to 3 days.



The longer scions are stored before grafting, the lower will be their suitability in terms of quality of the scions for grafting.

**d) Demonstrate the safe use of tools in harvesting cashew scions for canopy substitution**



Practical Exercise: Go to the farm for your apprenticeship to pre-select and then harvest scions with a knife or secateurs. Apply the knowledge that you have already gained from this section.

**e) Outline the procedure used to harvest cashew scions for canopy substitution**

Use the checklist to follow steps 1 to 7 in harvesting cashew scions for canopy substitution. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Activities	Rate
1. Go to the same scion bank in the early morning where you already prepared your scions	
2. Cut the scions with a sharp knife or secators at a length of 12 - 15 cm	
3. Wrap the scions in a moistened material or cloth and place it in a polythene bag immediately after cutting.	
4. Keep the polythene bags in a cool container	
5. Label all scions bundles properly by indicating the: <ul style="list-style-type: none"> <li>• Type of tree</li> <li>• Cultivar/clone</li> <li>• Date of harvesting</li> </ul>	
6. Transport scions in a moistened material or cloth and keep them cool in a shady place or in a cool box.	
7. Graft scions immediately after harvesting. Do not use scions three days after harvesting.	

*Be gentle with yourself. You are doing the best you can.*

**f) Harvest cashew scions for canopy substitution in cashew plantation**



Practical Exercise: Go to the scion bank and harvest cashew scions for canopy substitution. Remember that you have to pre-condition the scions by removing the leaves 4 - 7 days before harvesting.



## SELF ASSESSMENT

1. State the importance of cashew scion selection for canopy substitution.

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2. State the factors to consider in selecting cashew scions for canopy substitution.

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3. Outline the procedure for harvesting cashew scion for canopy substitution.

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*Congratulations! You have completed more than half of this training unit already. Take a deep breath and continue to the next chapter. You are doing great!*

#### 4. DEMONSTRATE SKILLS IN GRAFTING FOR CANOPY SUBSTITUTION IN CASHEW PLANTATION

##### a) State the factors to consider in grafting for canopy substitution

The number of shoots to be grafted is determined by the number of germinated shoots that developed around the edge of the cut surface.



Graft as many shoots as possible on the stump. The grafts should be spaced 15 – 20 cm apart around the edge of the cut surface.



Source: Yeboah (2018) – Grafted shoots on cashew stump



Grafting is done within three days after harvesting cashew scions, which is 45 - 60 days after stumping.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec



For more information on grafting, watch video on *Cashew Nursery Establishment and Grafting – Peace Corps Ghana* from Minute 6:52 to 9:13, and watch video on *Improved planting material - How to do cashew grafting* from Minute 2:45 to 5:33.

## b) Prepare tools and materials used in grafting for canopy substitution

The following materials are required for grafting:

- The most important tool for rootstock preparation is a very sharp **knife**.
  - You need a sharp knife to make precise cuts
  - Sharpen your knife until you can slice a piece of paper with it easily, that means it is sharp enough
- **Polythene graft tape** to join your scion and rootstock together
- **Poly caps** to protect the grafts from drying
- **Cotton** to clean the tools with **disinfectant** before and after grafting
- **Scions** that are not older than 3 days
- Use very sharp **Secateurs** to cut the stem of the rootstock



Source: GIZ/ComCashew – Grafting materials



Using unclean grafting materials can lead to contamination and infection of the rootstock and/or the scion. Always keep your grafting materials clean!

### c) Outline grafting procedure for canopy substitution

Use the checklist to follow steps 1 to 9 in grafting for canopy substitution. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Activities	Rate
1. Cut the shoot below the top two leaves	
2. Use a sharp knife or blade to make a vertical cut 3 - 4 cm deep passing through the middle of the shoot	
3. Select the scion of the same thickness as the shoot and slice the bottom part into a wedge or “v” shape 2.5 - 3 cm long	
4. Insert the scion into the wedge made in the shoot	
5. Tie the scion firmly with a grafting tape	
6. Ensure that the top and bottom of the graft union are fully wrapped with the tape	
7. Cover the grafted shoot with a polyethylene (plastic) cap and tie it underneath the graft union	
8. Provide enough shade with a 50 % shade net or natural materials for the top-worked stump in order to increase the percentage of recovery	
9. Observe the successful grafts and carefully eliminate the excess grafts	

*You can be proud of yourself, just in case no one has told you yet.*

d) **Graft selected shoots for canopy substitution in cashew plantation**



Practical Exercise: Select and graft a scion on the selected shoots for canopy substitution. Make sure that you use the appropriate tools and follow the grafting procedure meticulously.



Source: Yeboah (2018) – Grafting scion on shoots for canopy substitution

**The grafting procedure**



Source: <http://www.scielo.br/pdf/rbf/v40n1/0100-2945-rbf-40-1-e-586.pdf>





## SELF ASSESSMENT

1. State the factors to consider in grafting for canopy substitution.

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2. List the tools and materials used in grafting for canopy substitution.

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3. Outline the grafting procedure.

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*Bravo! One more chapter before you have completed this unit.  
Take a short break before you move to the last chapter.*

## 5. DEMONSTRATE SKILLS FOR NURTURING GRAFTED PLANTS IN CASHEW PLANTATION

### a) Explain nurturing of grafted plants

Nurturing of grafted plants includes graft inspection, care and checking for pest and diseases.



Unlike the grafted seedlings in a nursery, the stump does not require watering because the well-developed root system supplies the grafted shoot with the necessary water and nutrients.



Nurturing of grafted plants takes place at least 2 - 3 months after grafting, until the grafting tape can be removed.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

### b) State the importance for nurturing grafted plants

Nurturing your grafted plants is important to provide the fragile shoots with the necessary aftercare and protection against pest and disease attacks.



Graft care is important, so the grafting wound can heal and develop into a strong graft.



Source: GIZ/ComCashew – Well healed grafting wound

After canopy substitution, the tree begins to bear fruits within 1 - 2 years because the root system is already well-established.

### c) State the factors to consider in nurturing grafted plants

#### Nurturing practices of grafted shoots:

- Inspect shoots:
  - Remove new shoots that developed below the graft union
  - Check for pest and disease
  - Drain water from the polythene cap
- Remove all un-grafted shoots and unsuccessful grafts on the stump
- Check for signs of sprouting, successful grafts normally sprout within the first 10 - 15 days after grafting
- Remove poly caps 4 - 7 days after sprouting
- Remove the grafting tape 2 - 3 months after germination
- Stake grafted plants where necessary to avoid damage by strong winds

#### Nurturing practices of top-worked stump against pest and diseases:

- Drench soil around the stump with Dursban to protect the stump from termites and to control weeds around the stump
  - Mix 60 ml of solution per 15 litres of water
- Spray Cyperdim solution to prevent damage to the fragile shoots caused by sap-sucking pests
  - Mix 45 ml of solution with 15 litres of water

### d) Demonstrate the safe use of tools for nurturing grafted plants



Practical Exercise: Go to the farm for your apprenticeship for aftercare and nurturing of grafted plants. You require the same tools as you do during grafting. Apply the knowledge that you have already gained from this section.



Source: Yeboah (2018) – Staking grafted plants

**e) Outline the procedure for nurturing grafted plants**

Use the checklist to follow steps 1 to 8 in nurturing grafted plants. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Activities	Rate
1. Inspect shoots	
2. Remove all un-grafted shoots and unsuccessful grafts on the stump	
3. Check for signs of sprouting, successful grafts normally sprout within the first 10 - 15 days after grafting	
4. Remove poly caps 4 - 7 days after sprouting	
5. Remove the grafting tape 2 - 3 months after germination	
6. Stake grafted plants where necessary to avoid damage by strong winds	
7. Drench soil around the stump with Dursban to protect the stump from termites and to control weeds around the stump	
8. Spray Cyperdim solution to prevent damage to the fragile shoots caused by sap sucking pests	

*You do not need to master everything in one day. Take your time and progress at your own pace.*

**f) Conduct nurturing of grafted plants in cashew plantation**



Practical Exercise: Go to the farm for your apprenticeship and nurture grafted shoots and the top-worked stumps. Follow the recommended practices that you have already learned.



## SELF ASSESSMENT

1. Explain nurturing of grafted plants.

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2. State the factors to consider in nurturing grafted plants.

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3. Outline the procedure for nurturing grafted plants.

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*Fantastic! You completed this entire unit. Be proud of what you have achieved.*

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