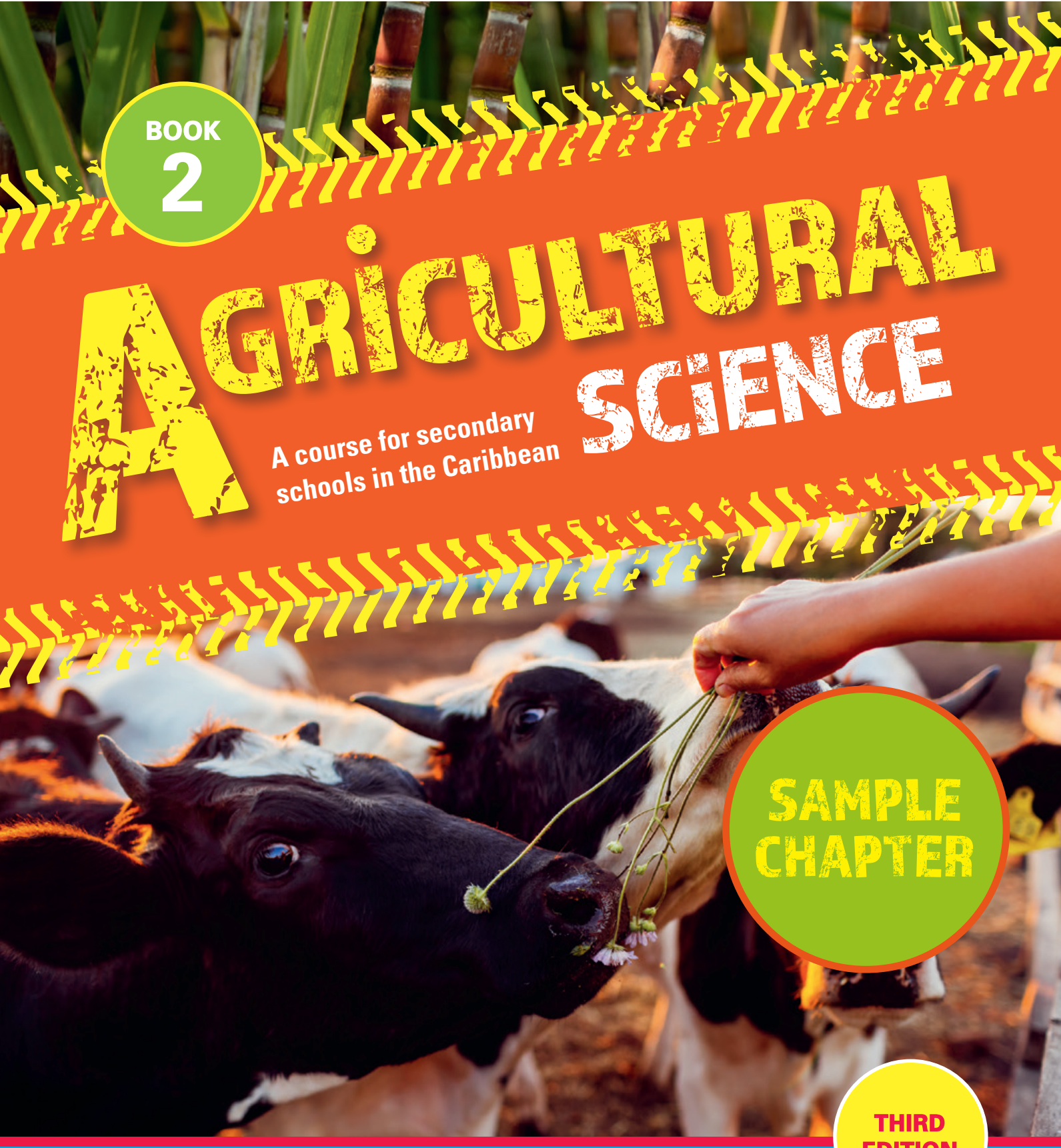
BOOK 2

AGRICULTURAL SCIENCE

A course for secondary schools in the Caribbean



SAMPLE CHAPTER

THIRD EDITION

Ian Elliot ■ Orville Wolsey ■ Amrith Barran
Augustine Vesprey ■ Edmund Berahzer
Joy Clarke ■ Michelle John
Ricardo Guevara

Boost
HODDER EDUCATION

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HODDER EDUCATION
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Chapter 1
Plant propagation

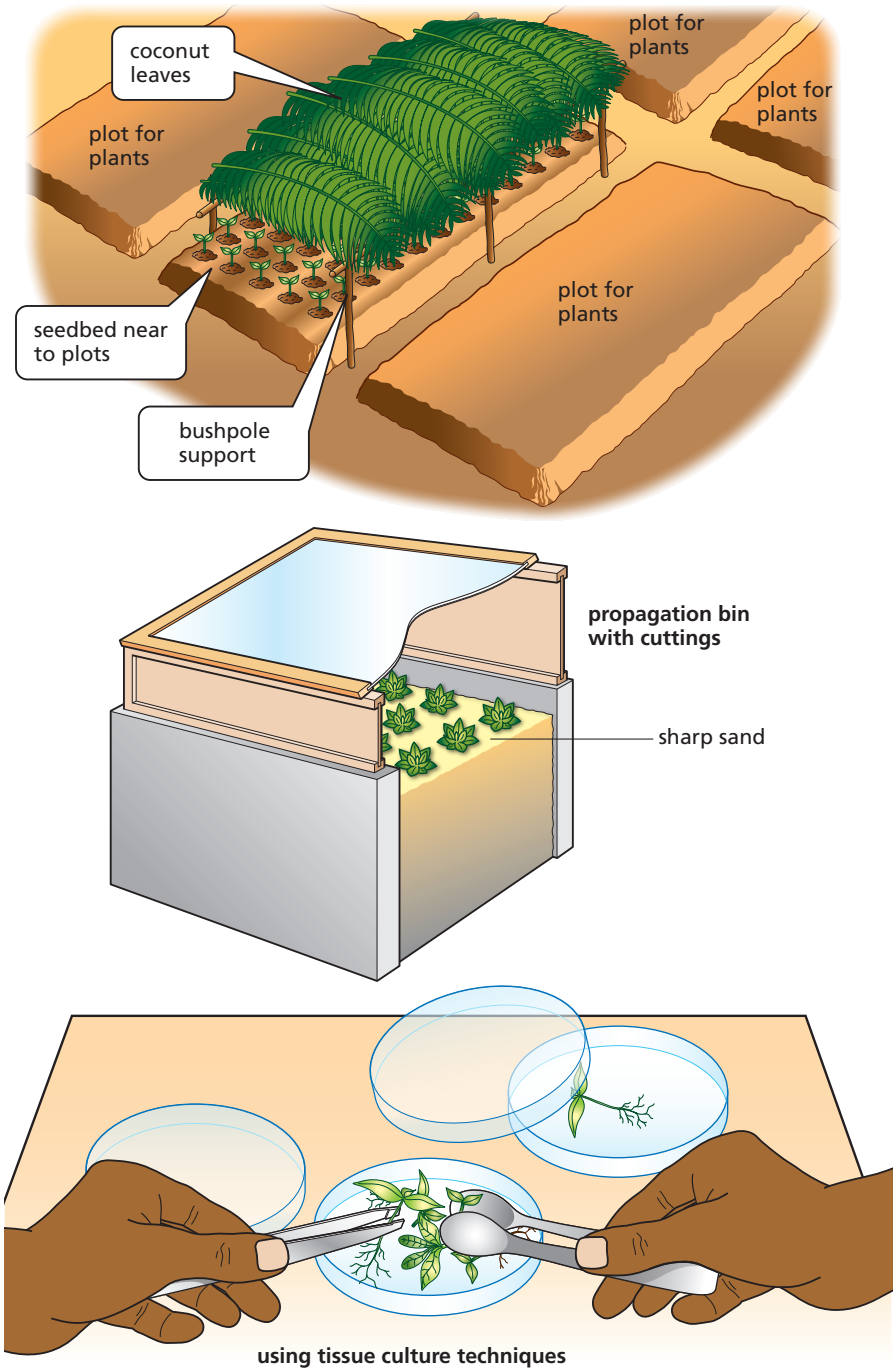


Figure 1.1 Some methods of plant propagation

At the end of this chapter you will be able to:

- Name the main methods of plant propagation and give an example of each method
- Define what is meant by a plant nursery
- List examples of vegetable crops that are grown from seeds sown in the nursery
- State the advantages of growing seeds in a nursery
- List the conditions for the successful growing of seeds in the nursery
- Describe the processes of soil sterilisation, disease control, thinning out and hardening off
- Explain how seeds are grown in seedboxes, seedbeds and seedling trays
- Prepare a seedbox for the germination of seedlings

Consider this

Under natural conditions, seeds are dispersed away from the parent plant to avoid overcrowding. During the **dispersal** process, seeds not only fall to the ground but are transported considerable distances away from the parent plant by the wind, by animals and by water in rivers and even the sea, as in the case of coconut. Dispersal ensures that the **seedlings** do not have to compete with the parent plant and with each other for soil nutrients, water, light and space in which to grow. For example, when a bird eats a cherry, the undigested seed is usually excreted some distance away from the tree. If the dispersed seeds encounter suitable conditions then germination will take place, resulting in seedlings.

Types of plant propagation

Besides germination of seeds, plants can also increase their numbers by modifying their **vegetative** parts to form new plants. A banana sucker, for example, is a new plant that has grown from the stem base of the parent plant. People have also developed techniques to increase the number of plants using parts of the original parent plants.

The process of increasing the number of plants from the parent stock is called **plant propagation**.

Plant propagation involves the following steps.

1. **Plant material needs to be used: this can be a seed or the vegetative part of a parent plant.**
2. **Dispersal of seed or a planting method: the seed has to be dispersed or distributed widely, or the planting material has to be placed in suitable conditions of moisture, soil and temperature.**
3. **Germination of seeds or growth of planting material takes place to form a new plant.**

There are two basic types of propagation: **sexual propagation** and **vegetative or asexual propagation**.

SEXUAL PROPAGATION

Sexual propagation in plants involves the bringing together of both the male and female parts of parent plants to produce seeds which will develop into a new **generation** of plants. In *Book 1* Chapter 8 (Plant processes) you learnt about the specific terms for the bringing together of the male and female parts of the parent plants: **pollination**, fertilisation, and fruit and seed formation.

VEGETATIVE OR ASEXUAL PROPAGATION

Vegetative or asexual propagation does not involve both parents. This process involves vegetative parts of the plant, such as stems, roots and leaves, which develop or are used to produce a new plant. It is the seedless multiplication of plants.

Types of vegetative or asexual propagation

There are two types of vegetative propagation.

- **Natural vegetative propagation**: this is when the vegetative reproduction of plants occurs naturally, for example in banana, pineapples, dasheen, yam and tannia.
- **Artificial vegetative propagation**: this is when people use techniques such as shoot **layering** and **cuttings**, **budding**, **grafting** and tissue culture. Tissue culture is a procedure in which very small parts of disease-free plant material are artificially stimulated via nutrients and **hormones**, in a controlled environment, to become new **plantlets**.

Subject link

This topic is also covered in integrated science, biology and botany.

COMPARING SEXUAL AND ASEXUAL PROPAGATION

The new plants arising from sexual and asexual propagation are given special names. The new plant that is produced from a seed is called a **seedling**, while the new plant produced from the vegetative part of the parent plant is called a plantlet. Table 1.1 compares sexual and asexual methods of propagation.

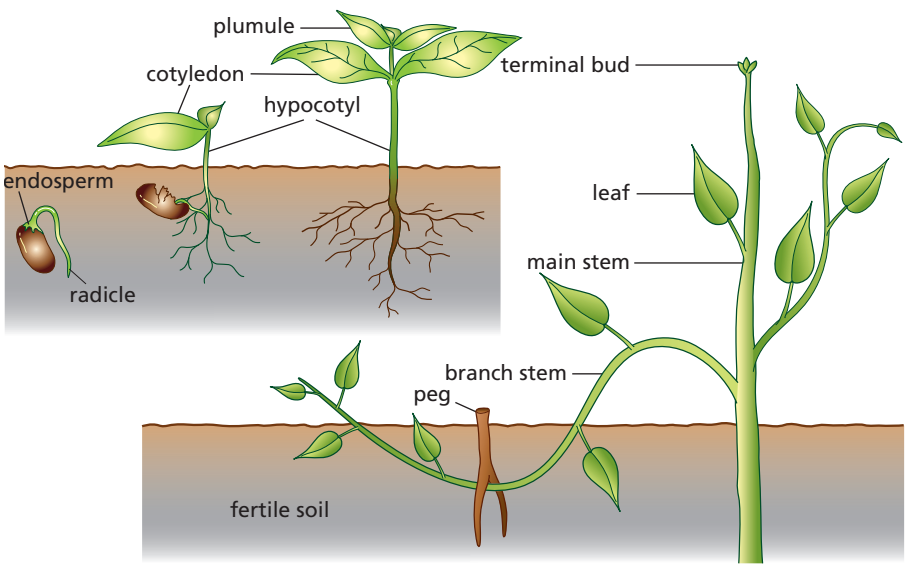


Figure 1.2 Sexual (top) and asexual (bottom) methods of propagation

Table 1.1 Asexual and sexual methods of propagation

ASEXUAL PROPAGATION		SEXUAL PROPAGATION
NATURAL	**ARTIFICIAL**	**USE OF SEED METHOD**
• The plantlet can get food from the parent plant. • The plantlet finds itself in suitable conditions of moisture, soil and temperature as the parent is already growing there. • The plantlet carries the identical characteristics of the parent plant. • Plantlets may be overcrowded when they all grow close to the parent plant.	• The plantlet may get food from the parent or is supplied artificially with plant nutrients. • The plantlet is nurtured in conditions of soil, water and temperature that have been specially created. • The plantlet carries the identical characteristics of the parent plant. • Plantlets can be planted at predetermined planting distances so overcrowding does not occur.	• The seedling has a definite amount of food stored in its cotyledons that may or may not be adequate for germination and initial growth. • Some seeds are dispersed away from the parent plant to places where they cannot germinate, for example stony areas. They need adequate water, soil and the correct temperature. • The seedling carries the **genetic** characteristics of both parents, which may result in the creation of a new variety of plant. • Seedlings can emerge over a wide area and will be scattered well away from the parent plant because of seed dispersal.

The plant nursery

WHAT IS A PLANT NURSERY?

A plant **nursery** is a place where young crop plants are produced from seeds or vegetative parts and grow for a length of time before they are transplanted to the field. In the nursery, competition among young plants and the negative effects of the environment are controlled.

THE NEED FOR A PLANT NURSERY

During natural vegetative propagation, plantlets or seedlings find themselves overcrowded in an area. This increases the competition between the parent plant and plantlets for water, sunlight and nutrients, and results in poor yield. A plant nursery overcomes the problem of overcrowding by planting seeds or seedlings at well-spaced intervals. Plant nurseries also protect plants from bad weather.

Proper nursery management increases the rate of successful plant propagation when compared with the random process occurring in nature.

TYPES OF NURSERY

There are two types of nursery based on the type of propagation material: the seedling nursery and the plantlet nursery.

- The **seedling nursery** is mostly used to increase the success of the sexual propagation process. Seeds are sown and the young seedlings are managed and cared for to reduce losses. This increases the number of healthy seedlings produced. There are vegetable seedling nurseries (vegetable nurseries) and tree seedling nurseries.
- The **plantlet nursery** is mostly used to improve the rate of success of the vegetative propagation process resulting in healthy plantlets.

You can also classify nurseries as being stationary or mobile.

- The **stationary/traditional nursery** is where young plants are planted directly in specially prepared **seedbeds**. Later on, when the seedlings or plantlets are bigger and stronger, they are removed from the seedbed and transplanted into the field.
- The **mobile/container nursery** is where the young plants are raised in seedling trays, potting bags or other types of containers which can be moved around in the nursery easily. When these young plants are bigger and stronger, they are removed from their containers and transplanted into the field.

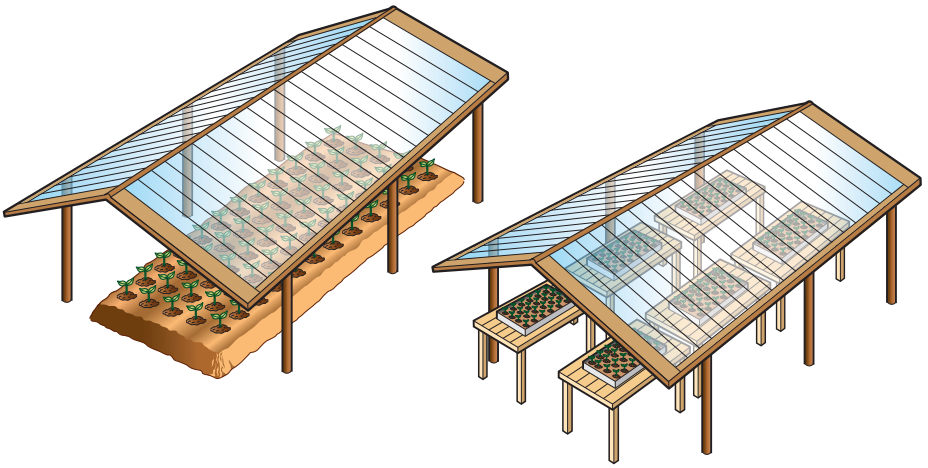


Figure 1.3 Two different types of nurseries: a traditional nursery (left) and a container nursery (right)

A third method of classifying nurseries is based on the level of protection that is afforded to the young plants.

- **Field seedbed nursery**: an area of land where seedbeds are prepared for sowing seeds which will grow into seedlings to be transplanted. Traditionally, field seedbeds are prepared near the farmer's house or in a special area in the field.
- **Protected cultivation nursery**: this includes the most sheltered part of the farm, often using a greenhouse and computer-controlled greenhouse structures.

Vegetable crops grown from seed in a nursery

Vegetables are the edible leaves, roots or stems of herbaceous or soft-stemmed plants. The fruits and seeds of certain plants, such as the tomato (*Solanum lycopersicum*), are sometimes regarded as being vegetables.

The vegetable seeds used for sowing in a nursery should be from healthy, high-yielding parent plants and show a high germination percentage. In addition, they should have good seedling vigour and trueness to type. Examples of seeds sown in a vegetable nursery include cabbage, tomato, eggplant or melongene, peppers, lettuce, spinach and onions.

Seed selection is a very important step in the process of producing high-quality seedlings. High-quality seeds can be obtained from commercial seed suppliers and from on-farm seed collections.

COMMERCIAL SEED SUPPLIERS

The seeds supplied by commercial suppliers must be checked to ensure that they have the following characteristics.

- The seeds are fresh seeds packaged for the current year. Remember that the germination rate of most seeds drops dramatically after the first year.
- The seeds should have an expected germination percentage of 65–80%. Note that of the seeds that germinate, only 60–75% will grow into healthy seedlings.
- The seedlings will be able to meet the farmer's requirement of size, colour and growth habit.
- The seeds are properly packaged with information on the packet or in the seed catalogue about the number of days to maturity, the country of origin of the seed, specific germination and cultural requirements, disease resistance, chemical treatment of seed against diseases, and so on.
- Seed supplies are free from **weed** seeds, inert materials and other seeds.

ON-FARM COLLECTION OF SEEDS

Seeds collected from the field should be:

- from plants that are self-pollinated, non-hybrid and which produce annual vegetable seeds, such as beans and tomatoes
- legally permitted to enter the country (do not collect seeds or plants while on vacation in a foreign country; they may introduce **pests** and diseases into your country)
- collected from healthy, high-yielding plants.

The seeds of pulpy fruits such as cucumber should be harvested just before the fruit is fully ripe. Seeds should be separated from the pulp, washed and thoroughly dried.

STORAGE OF ON-FARM COLLECTED SEEDS

- Properly stored seeds can remain viable for a number of years. Generally, before seeds are stored they must be dried completely. Dried seeds are placed in airtight containers and stored in conditions of low temperature and low moisture, such as a refrigerator. The germination rate of stored seeds must be checked before planting. If it is 70% or less, buy new seeds.
- Many vegetable seeds that are kept for a relatively short period of time from harvest to the following sowing season are left in open storage. Open storage is where the seed packet is not sealed.
- Onion and parsley are short-lived seeds. They will germinate immediately after they have ripened or they will lose their viability. These seeds must be sown immediately on ripening.

MEASUREMENT OF SEED QUALITY

The main measures that are taken to determine the viability and vigour of seeds are seed purity, germination percentage and seedling viability.

- **Seed purity**: take a representative sample from the seed lot and make a visual division into good seeds, other crop and weed seeds, and inert materials such as soil, stones, etc. Determine the percentage of pure crop seeds by dividing the number or weight of pure seeds by the total sample number or weight of seeds and multiplying by 100.

- **Germination percentage**: a known number of seeds are placed under optimal growing conditions and the number of germinated seeds counted over a period of 1–4 weeks. Seeds are divided into normal seedlings, hard or ungerminated seeds, and abnormal seedlings. The normal seedlings are considered to have passed the germination test. Determine the germination percentage by dividing the number of normal seedlings by the total number of seeds sown and multiplying by 100.
- **Seedling viability**: within the standard germination test, count the number of seeds germinating on a daily basis. The time taken to reach a given germination percentage, such as 50%, is used as a guide to seed lot viability.

Activities

Practical work

Finding sources of quality seed in your country

Plan a research project to find the sources of seeds that farmers in your country use. Your teacher may divide you into groups.

1. Each group should visit existing agribusinesses in their area, perhaps accompanied by a parent.
2. For each agribusiness visited, determine the seed quality, packaging, seed supplier, type and conditions of storage, and quantity of seeds lost per year due to poor storage.
3. Prepare and make a presentation on the group's findings.

Technology-based activity

Your findings for the practical work above can be presented as a PowerPoint, video, slide presentation or poster presentation. Ask your teacher to invite representatives from the businesses you visited to see your presentations.

Advantages of raising seedlings in a nursery

In the natural environment, many of the seeds dispersed from the parent plant will not fall where conditions are right for successful germination. Also, many seeds that do germinate will not develop beyond the seedling stage. Diseases, weeds, competition among seedlings and destruction by animals usually result in high seedling losses.

There are additional problems when vegetable seeds are sown directly in their permanent location in the field. For example, the farmer may have to travel long distances to care for seedlings. Also, seeds sown directly into the field are more vulnerable to solar radiation, wind and heavy rain, making it very difficult and costly to produce very large numbers of plants.

Raising seedlings in a nursery has the following advantages:

- It is often the easiest and cheapest way to produce large quantities of seedlings.
- It is the only way to propagate certain species of plants.
- It can be used to avoid and control pests and plant diseases.
- Most annual and biennial plants are grown easily from seeds.
- At the nursery you can select the strongest and best plants for transplanting into the field.

Did you know?

Soil temperature affects germination of seeds. Low temperatures can slow down germination, reduce the germination percentage and prevent seedlings from emerging. High temperatures can cause seed dormancy. The minimum germination temperature varies with plant species.

Conditions for successful nursery seed germination

The following conditions are necessary for successful nursery seed germination.

- **Seed quality**: good-quality seeds should be used. These should be whole and without damage from insects, fungi or bacteria. They should be collected from healthy plants only.
- **A good planting medium**: this is a medium which offers good aeration, good water-holding capacity, the ability to supply nutrients, a fine tilth and freedom from soil pathogens (micro-organisms which cause plant diseases).
- **A favourable soil environment**: for example, soil moisture and soil temperature should be favourable for germination of the seeds of specific crops.

Processes in the nursery

Processes in the nursery include preparation of the planting medium, sowing seeds, seedling care and management, pest and disease control, and **hardening off**.

PREPARATION OF THE PLANTING MEDIUM

The planting medium is the nursery mix into which seeds are sown. Often this medium is seed-sowing **compost**.

Soil is the universally available medium for germinating seeds. However, some soils are unsuitable for growing seedlings and must be mixed with manure. Certain naturally found materials can be collected and mixed together to create an 'ideal medium' for seed germination. Coconut coir dust, well-decomposed manure or well-decomposed sawdust are used in the nursery to improve the aeration and water-holding capacity of a planting medium. Fertile soil and chemical **fertilisers** are added to the nursery mix to enhance its capacity to supply nutrients.

Special mixtures of perlite, vermiculite and peat, locally known as Pro-Mix, are commercially available as ready-to-use substitutes for soil.

STERILISATION OF THE PLANTING MEDIUM

Sterilisation is a process used to eliminate bacteria and other harmful micro-organisms from the planting medium or seed-sowing compost. This can be done either by using heat or by using a chemical such as formalin.

Heat sterilisation

A perforated tin containing seed-sowing compost is placed on a grid inside a bigger tin which has water in the bottom. The whole apparatus is heated over a fire until the water boils. The compost is then steamed for 30 minutes to kill any organisms or weed seeds present. Then the compost is spread out to cool and dry, and is ready for use.

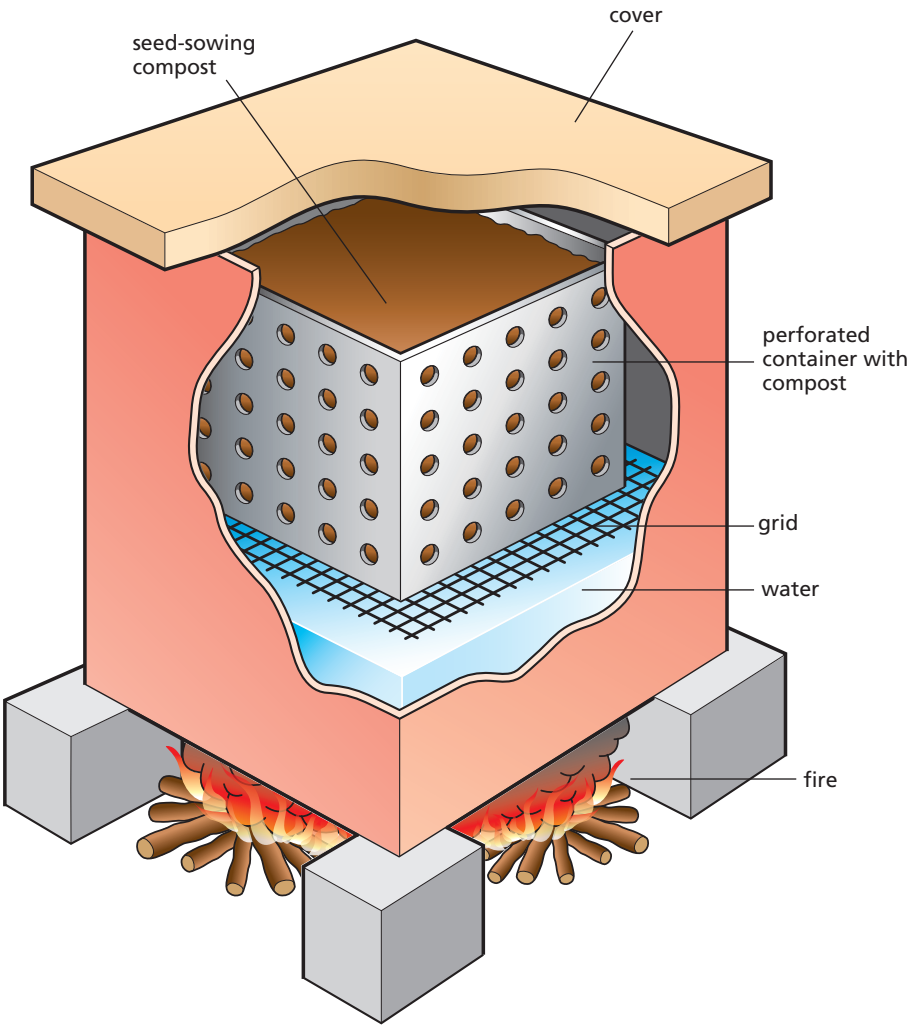


Figure 1.4 Heat sterilisation of the planting medium

Chemical sterilisation

The seed-sowing compost is spread on concrete or on hard flat ground to a depth of 10 cm. The sterilising chemical is applied using a watering can with a rose. The compost is then covered with plastic sheeting and left for 14 days to ensure that all insects, fungi, weed seeds and nematodes (eelworms) are killed. Then the compost is uncovered and dug over. This aerates it and allows the chemicals to evaporate so that seedlings planted in it later will not be affected.

Career corner

Garden shop manager/worker

Figure 1.5

For this month's profile we had the pleasure of chatting with Michelle Bailey, the manager/owner of Green Thumb Garden Supplies Centre.

Interviewer: Tell us a bit about how you got into owning and managing a garden supplies store.

Owning a garden supplies store was a dream of mine from when I was in school. Agriculture has always fascinated me. As a child I was always trying to grow things. I grew peas and graduated from that to bigger crops that we would eat at home. After high school I did some TVET training in agriculture which helped to pull together what I learnt in my agricultural science classes in high school. I also did a few short courses in accounting and management because I wanted to be able to oversee every aspect of the business. While I was doing these courses, I was also doing some research about where the business should be located, what products would sell best and how much capital I would need to invest. I wrote a business plan and approached my credit union for a loan. I was turned down the first two times, but with the help of a mentor, I was able to refine the business plan and secure the loan.

Interviewer: How long have you been in business and how has the experience been for you?

We celebrate our sixth year of operation later this year. There have been many challenges! At first our customer base was very small, mostly the curious, but when they came in and saw our range of services, they came back and recommended us to their friends and family. In that first year, we had a major tropical storm which destroyed many items of stock which were stored outdoors. That set us back quite a bit, but luckily we had insurance and were able to recover and now have better storage for such disasters. Despite those challenges it has been a very rewarding experience so far. The business is growing and I have learnt quite a bit.

Interviewer: What are your main duties as owner and manager?

I'm involved in just about everything! We are not yet at the point where we can have departments dealing with the different parts of the business. Until we get large enough, I supervise all the operations involved in running a garden supplies store, including the sale of plants, flowers, garden tools, fertiliser, seeds, pesticides, etc. I also employ and manage staff, and maintain the budgets, records and accounts.

Interviewer: Where do you see your business in another five to ten years?

We have one successful store now, and I want to use this as a model to establish other garden supplies centres in the busier towns across the island. Each will be different, catering to the needs of the customers in those locations, but we'll always maintain our core values.

Interviewer: You do have a great store here. I always find something interesting to buy when I come in and I appreciate the service provided by your staff. All the best with your plans for the future!

Thank you so much. It is always reassuring to know that we are providing a great service. We are truly committed to becoming a one-stop shop for everything from cut flowers to landscaping to farming and anything in between.

Sowing seeds in the nursery

Depending on the size of the seeds, you must first make small holes in the planting medium or cut drills to a certain depth in the planting medium. To sow the seeds, place them into the holes or drills in the planting medium and cover with the medium.

In the nursery, seeds are sown in specially prepared seedbeds, **seedboxes** or other containers. They can also be sown in seedling trays. One particular type, called **Speedling trays**, is very popular in the Caribbean. These trays are made of styrofoam with regularly spaced individual seedling cubicles for filling with growth medium.

USING SEEDBEDS

First, choose the place for your seedbed. Then measure out beds 1.5 m long and 1.0 m wide and set lines to mark the edges of each bed. Separate beds on the long sides with furrows of 0.25 m wide and about 0.25 m deep. Make sure that when you are in the furrow you can reach the middle of the bed with your hands. This will enable you to conduct all the necessary planting and cultural practices, such as weed control, easily.

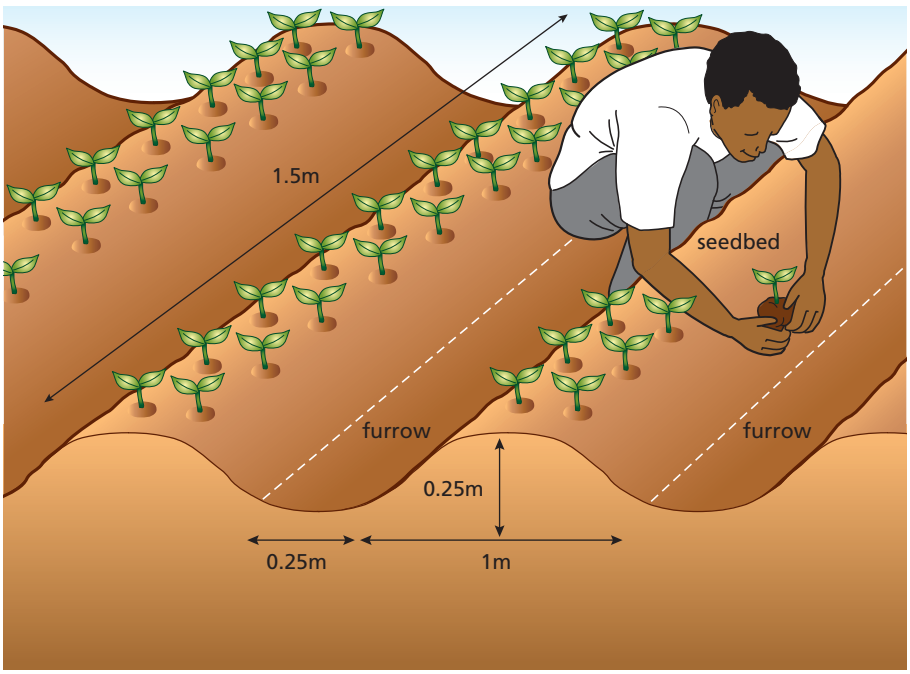


Figure 1.6 Seedbeds can be made to these dimensions

Now add to the seedbed some compound fertiliser (such as 10 : 15 : 5) at a rate of 50 g per square metre and ammonium sulfate at 30 g per square metre. Fork the ground over lightly to break up big lumps. Remove any large stones. Firm the soil with your feet. Rake it to leave a fine tilth ready for sowing the seeds.

Using a measuring rod, set lines 15 cm apart running the length of each bed. Then, following the lines, draw drills 1 cm deep for sowing the small seeds. Sow the seeds thinly with your fingers. Cover them with soil and lightly firm the soil with your hand. After sowing you need to irrigate the seedbeds and then make sure that they are regularly watered. Lack of water will prevent the seedlings from developing.

USING SEEDBOXES

Sometimes gardeners sow seeds in small seedboxes filled with specially prepared compost or **potting soil**. Many farmers also use these to germinate very small vegetable seeds, such as sweet peppers, tomatoes, parsley and thyme. Using seedboxes gives the seeds a good start in life and means that very few are wasted.

Seedboxes can be made from old wooden crates or any old pieces of sawn wood. The standard size is 35 cm by 25 cm by 7 cm. Gardeners have found by experience that this is a convenient size. The boxes are small enough to be handled and moved about easily, and they are just deep enough to allow room for root growth.

Preparing the seed-sowing compost

To prepare seed-sowing compost or potting soil, follow the steps detailed in Table 1.2. Put all the ingredients in one heap and turn this over a number of times using a spade to ensure the ingredients mix together. Finally, sieve the compost to remove any big lumps.

Table 1.2 The composition of seed-sowing compost

PARTS	ITEM	REASON FOR INCLUDING THIS
1	Good garden soil	Rich in nutrients
2	Pen/compost manure	Rich in nutrients, helps to separate clay particles
2	Coarse sand	Helps in drainage
1	Peat	Improves the structure of the compost
50 g	Ammonium sulfate	Stimulates leaf growth
100 g	Calcium carbonate	To correct acidity caused by sand and ammonium sulfate
50 g	10:15:5 fertiliser	Stimulates leaf and root development (if fertiliser is not available, then increase the pen/compost manure by one part)

Filling the seedboxes

Put dried grass or straw in the bottom of the seedbox to prevent soil falling through the slits at the bottom created for aeration and water drainage. Then add 3.5–4 cm of unsifted compost or potting soil, followed by sifted soil, which is pressed down using a board, to a depth of 1–1.5 cm below the top of the seedbox. This gives a level, smooth surface for seed sowing and leaves the sides of the box slightly higher all round to prevent compost from being washed out of the box when watering. The board can be fitted with a handle to make it easier to use.

Sowing seeds

When sowing seeds, make drills 2 cm apart in the seedbox using a dibber, which is a pointed wooden stick. Sow the seeds by sprinkling them thinly using your fingers and cover by scattering compost lightly from a fine sieve. Press the surface again with the board to make sure that the soil is in close contact with the seeds.

Water the box with a watering can which has a fine rose. It is important not to splash the seeds about. Cover the box with plastic, or with a sheet of glass, until the seeds germinate.

Revision tip

Building and preparing a seedbox are popular practical topics so practise until you can perform these activities confidently without checking your notes.

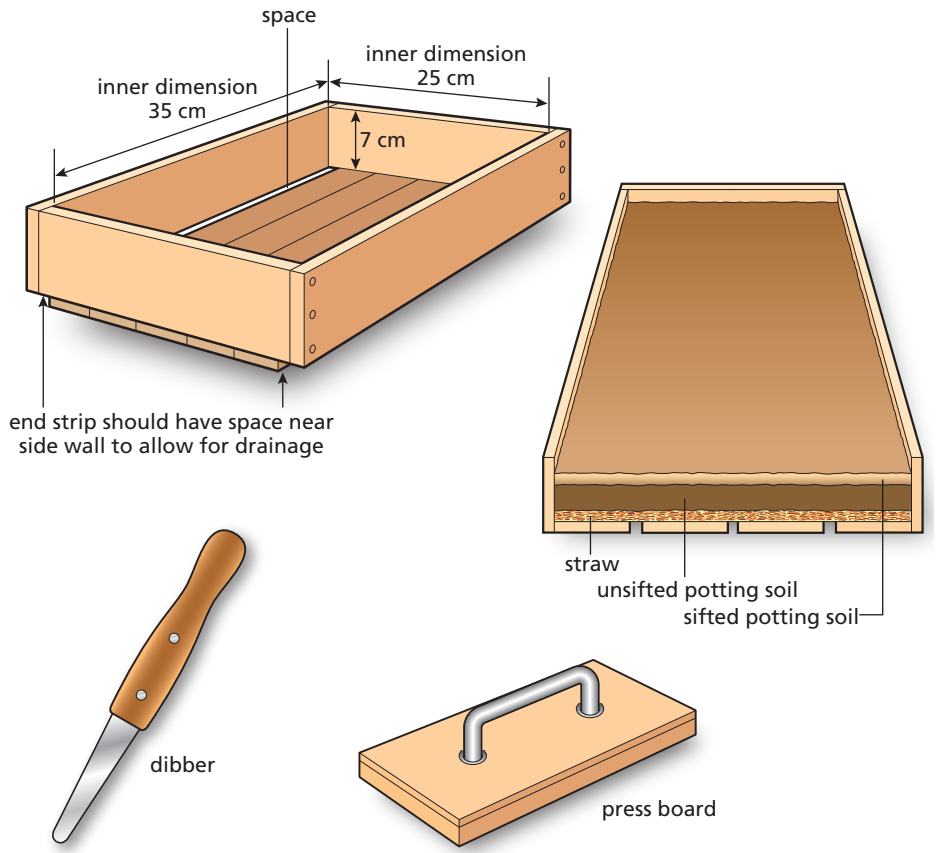


Figure 1.7 Seedboxes are made to specific dimensions and must be prepared before sowing seeds

Thinning out

Once the young seedlings begin to grow and are 2–3 cm high, they can be moved to other boxes, by a method known as **thinning out**. More seedboxes are prepared and the seedlings are then transplanted into holes dug in the soil with a small dibber. The plants are grown here until they are ready to be planted out into the field. Commercially available trays can be used for thinned out seedlings, such as Speedling trays.

Using Speedling trays

This involves sowing seeds in individual cells in a tray. This method has several advantages. Most importantly, the root system of the seedling is not damaged during transplanting as can happen when using the seedbed or seedbox methods.

Polystyrene trays and rigid plastic trays can both be used to sow seeds. Trays carry names such as 308, 196, 125, Hassy 308, Hassy 104, multicell 308, GPG 345 depending on the size, shape and number of cells and the material the tray is made from. The shape of cells can be cylindrical, a truncated inverted cone shape or a truncated inverted pyramid shape.

Plant seeds to depths of roughly twice their diameters or width. For very small seeds e.g. celery, place these on the soil mix and cover lightly with sifted soil.

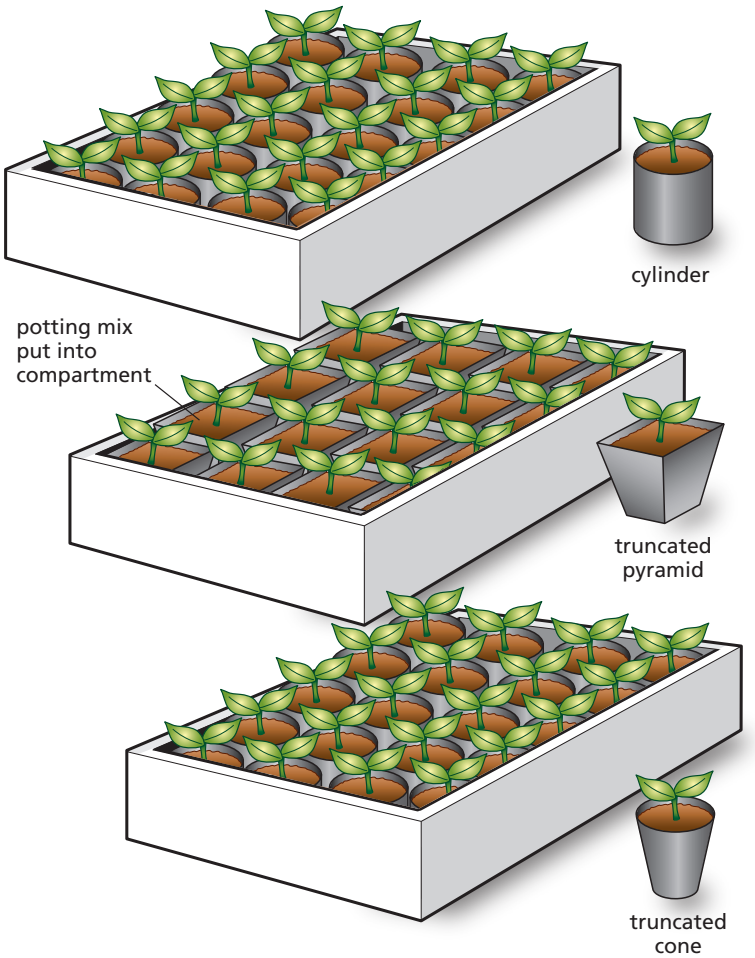


Figure 1.8 The shapes of cells in Speedling trays

Alternative sowing methods

Alternatively, you can use peat pellets for sowing seeds. Small compressed discs or pellets of dry peat enclosed in a mesh can be obtained from garden shops. When soaked in water, each pellet forms a cylinder into which one seed can be sown. Once the seedling attains field size, the mesh is removed. The entire pellet and root system can then be placed into the soil.

Disposable food and drink containers can also be used as seedling containers. This is a way to reuse and recycle various previously discarded containers. Recycling containers helps to conserve the environment.

SEEDLING CARE AND MANAGEMENT

The care activities that are conducted on seedlings depend on the type of nursery in which the seeds are sown.

Care using field seedbeds

Mulch: cover the seedbed with a thin layer of cut grass or a sheet of plastic. This helps to prevent seeds from drying out. As soon as the seedlings rise above the ground, remove the mulch. Young plants need light and air.

Water: water the seedbed twice a day, using a watering can with a fine rose. Be careful not to wash the seeds out of the ground. When the plants are about 5 cm tall, you can water just once a day.

Shade: shade the seedlings when they rise above the ground. A shade frame made from wooden poles or shrubs covered with coconut or similar leaves stops the Sun from drying out and killing the plants.

Thinning out: thin the seedlings in the seedbed after 2 weeks if they seem too crowded. Remove weaker plants and leave the stronger ones more room to grow.

Fertilisation management: phosphate fertiliser should be worked into the nursery bed to improve the root system. With the addition of well-rotted manure, it is seldom necessary to give additional fertiliser during the nursery stage.

Care using Speedling trays

Water: water very carefully, especially when the seeds are small. Large water drops tend to erode the soil above the seeds, exposing them to the drying effect of the Sun. As the seedling develops, more water must be applied. Water should come from a safe source free from weed seeds and disease-causing organisms.

Fertilisation management: even with a well-prepared medium, because of the limited amount of 'mix' available to each plant in its individual cell, certain nutrients may be lacking. This makes it necessary to fertilise seedlings with soluble fertilisers. The frequency of fertilisation and the strength of the nutrient solution depend on the fertility status of the soil mix and the state of the seedlings. Use preparations that have a high phosphorus level. However, too much fertiliser may cause crop damage.

PEST AND DISEASE MANAGEMENT

Pests and diseases can affect the vegetable nursery, causing reduction in the quality of seedlings. Both the development and yield of the transplanted seedlings may suffer. In many cases pests and diseases can cause total loss of the seedlings in the nursery.

Diseases

Proper seed selection, good drainage and management of **humidity** are important to avoid disease development. Over-watering can cause the 'damping off' fungus to attack the stems of seedlings at the point of contact with the soil, causing the plant to fall over and die. This usually happens within the first 2 weeks after germination. You need therefore to avoid over-watering and also to avoid overcrowding of seedlings; fungi grow best in moist, warm conditions. If damping off is likely to be a problem, you can dress seeds with a suitable fungicide.

Chemical fungicides such as Manzate, Ziram, Benlate and Champion are sometimes used to help manage diseases in the nursery.

Soil sterilisation reduces the chances of other diseases such as bacterial wilt, bacterial specks and spots. Seed treatment will reduce the chances of seed-borne diseases.

Pests

The chances of pest infestation in the nursery can be reduced by keeping the surroundings free of host vegetation such as vines or avoiding the cultivation of crops close to the nursery area. The main pests for the seedling nursery are caterpillars, leafminers, aphids and mites. These pests can be controlled using **insecticides** such as Malathion, Basudin, Karate and Kelthane (mites).

Did you know?

Mice are pests of seedlings and can cause great damage in a plant nursery. They can be controlled using appropriate baits.

HARDENING OFF

Hardening off is the process of acclimatising seedlings to natural conditions. The purpose of hardening off is to prepare plants to withstand stress conditions in the field. These may be high temperatures, drying winds, low soil moisture or injury to roots during transplanting.

The growth rate reduces during hardening off. Growth is resumed again after transplanting.

Revision tip

Sowing seeds in seedbeds or seedboxes, thinning out, hardening off and transplanting of seedlings are popular assessment practical activities so make sure to revise your notes on these and practise until you are competent!

Hardening off in field seedbeds

Two weeks before transplanting, remove some of the leaves from the shade frame each day. This lets the young seedlings get used to strong sunlight. After a week, you can take away the shade frame altogether. This helps with hardening off.

Hardening off using seedboxes and Speedling trays

Hardening off can be achieved by gradually exposing the plants to more sunlight, wind and rain over the last 2 weeks in the nursery. For more information on this, see page 35.

Food for thought

The big question

What do you think about the development of large regional seed banks?

Breaking this down

1. **What purposes do seed banks serve?**
2. **Where are the major seed banks of the world?**
3. **What are the advantages and disadvantages of your country accessing resources from seed banks outside of the region?**
4. **What are some of the things to consider if creating large seed banks in the region?**
5. **What would be the advantages and disadvantages of having large seed banks in the Caribbean?**

Sharing the information

Consider an in-class debate. One side can argue for having seed banks in the Caribbean while the other side can argue against that.

After the debate it would be good to take the time to really talk about the important points raised by both teams, so that you have a comprehensive understanding of all the ideas to be considered.

Answering the big question

Now that you've done the research and participated in the debate and post-debate discussion, what are your personal thoughts? Do you think it is a good idea to have large seed banks in the Caribbean? Ensure that you are clear in your mind about why this may be a good or bad idea.

Activities

Practical work

Nursery visit

Ask your teacher to take you to visit a plant nursery. At the nursery, observe and record:

1 the type of nursery (based on propagation materials used, mobility and level of protection)
2 the various features of the nursery and the effects they have on the germination, growth and development of seedlings.

Draw a diagram of the nursery and add to your diagram the main features.

Technology-based activity

Use the internet to investigate the technology used in the large-scale production of seedlings in the Caribbean and the organisations which carry these out. Prepare an information sheet on this to share with your class and farmers in your community.

What have I learnt?

Multiple choice questions

1 Which crop is not grown from seeds?
- a Tomato
- b Melongene
- c Lettuce
- d Banana

2 Conditions necessary for growing seeds in a nursery are:
- a good-quality seeds
- b good planting medium
- c favourable soil environment
- d all of the above.

3 A crop that is not propagated by an asexual method is:
- a pineapple
- b banana
- c eddoes
- d peppers.

4 A good planting medium comprises:
- a soil and sand
- b soil and coconut fibre
- c soil and manure
- d soil, manure and coconut fibre.

5 Sterilisation of the planting medium:
- a is used to kill helpful soil micro-organisms
- b can be done by heat or using chemicals
- c is not necessary when using plant compost
- d is only done by large-scale farmers.

Short answer questions

1 Name three vegetables usually sown in specially prepared seedbeds for transplanting later. What are the advantages of raising plants in this way? What are the disadvantages of sowing seeds directly into their permanent location in the field?

2 Describe how to prepare a seedbed. Give details of spacing and depth of sowing. Explain how you would look after the seedlings as they begin to grow, including mulching, watering, shading and thinning.

3 Describe how to make a seedbox to hold 35 seedlings. Give the inner dimensions of the box and explain the advantage of limiting it to this size. How can you make sure the box is well drained?

4 Give three good reasons for sterilising soil that is to be used for making up a seed-sowing compost. Describe one method of sterilising the soil. What is 'damping-off' disease and how can it be prevented?

5 List the ingredients of a seed-sowing compost or potting soil. In what ways is this compost better for raising seedlings than a normal garden soil? What is meant by the term 'thinning out' of seedlings?

6 Briefly describe how to prepare the planting medium in a seedbox for sowing lettuce seeds.

7 What is sexual reproduction? Compare this with asexual reproduction.

8 What is meant by 'hardening off'?

9 Why do you 'harden off' seedlings?

10 Name four methods of artificial vegetative propagation.

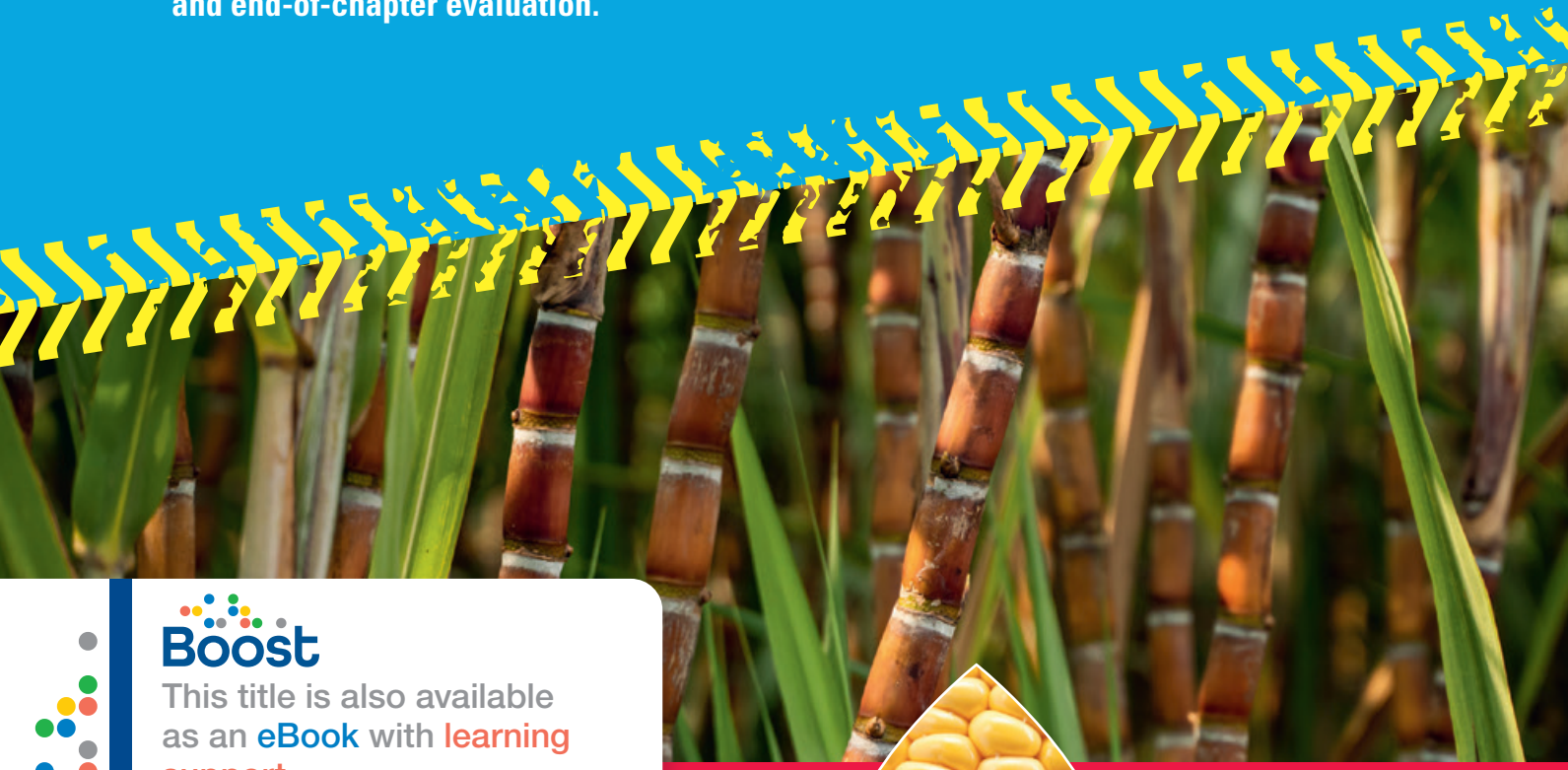
AGRICULTURAL SCIENCE

BOOK 2

Cultivate an interest in the agricultural sector with a three-level secondary course designed specifically for the Caribbean.

- **Explore regional and global practices and developments in agriculture.**
- **Review career options in an increasingly lucrative and essential sector.**
- **Enhance understanding of the relevance of agriculture with a project-based approach to select topics.**
- **Prepare for study at the CSEC® level with a dedicated project-based chapter scalable to other topics and SBA research at the CSEC® level.**
- **Consolidate learning with clear chapter objectives and end-of-chapter evaluation.**

SAMPLE CHAPTER



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