module four: plant propagation

aims

The aims of this module are to enable you to:

- learn how to germinate and grow seeds successfully
- explore different methods of propagation
- explore different types of cutting
- learn about layering, division and grafting

context

Propagation is a key aspect of the horticulturist’s role, and in this module we shall be exploring different methods of propagation, and considering when each of these might be most appropriate.

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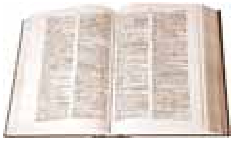
introduction

Many plants can be propagated in more than one way, but they are usually more suited to one method than another. In addition, you may find that one method suits your needs more than another. While annuals are normally grown from seed, perennials are more often propagated using cuttings or layers. Raising perennials and even shrubs or trees from seed can be a satisfying challenge, but it is often a slow and uncertain process. Vegetative propagation is often quicker and of more practical use.

We will be covering six important method of propagation in this module: from seed, cuttings, layering, division, grafting and budding, and micropropagation.



Read Chapter 7 of *Principles of Horticulture* from page 67, *'The Vegetative Plant',* to *The Flowering Plant*, on page 73, which gives some background on the material in this module.

growing from seed

The most basic form of propagation, this technique is commonly used for annuals, or by growers who need a large number of a particular perennial species. Most seed packets give practical advice on sowing depth, light requirements and temperature needs. You may find that advice varies from one brand to another, and this may be because the varieties are slightly different, or it may simply be because different experts take different approaches.

Why do you think are the main advantages of growing from seed? What are the main disadvantages?

The points we thought of here are:

advantages

- **Volume** - plants can easily be grown in large volumes from seed, since most species produce many seeds in each generation.

- **Cost** - this is an economical way of growing in bulk.

- **Choice** - There are a wide range of species and varieties to choose from.

- **Reliability** - As noted in the textbook, the Seeds Acts mean that quality is carefully controlled, so as long as you provide favourable growing conditions you will achieve a good germination rate.

- **Storage** - In dry, cool conditions most seeds can be stored for a long period of time if required, and they take up very little space.

- **Easy** - Most plants are quite easy to raise from seed and some can even be sown directly into the ground.

disadvantages

- **Time scales** - some plants take a long time to grow from the seedling stage to maturity.

- **Not true to type** - some plants, including cultivars and hybrids, may be quite different from their parents. This can be a particular problem for gardeners collecting seed from previously purchased specimens. A related problem is that many of the seeds from such plants may be sterile.

seed saving

The majority of growers will purchase their seed from a specialised seed company, but sometimes both gardeners and professional horticulturists may wish to collect seed themselves.

What advantages do you think this might have?

We thought of the following:

- It saves money because home-produced seed costs virtually nothing.

- It enables one to protect and preserve a favourite variety - especially important for older varieties which may be difficult to obtain from seed catalogues. Also essential for horticulturists developing new cultivars.

- It gives you the opportunity to select a strain that responds to your soil, climate, growing technique and your particular crop requirements - flavour of fruit, drought resistance, precise flower colour and shape, and so on.

When growing vegetables for seed bear in mind that some species are biennial: carrots are an example. We normally harvest them halfway through the cycle of growth when we take the roots. To complete the lifecycle and produce a seed head requires a further season of growth.

safety tip

Hygienic conditions and sharp, clean tools are essential for any form of propagation.

This is an important point to mention if you are asked a question about propagation in the exam.

Avoid saving seed from hybrids. As we saw earlier in the course, these have been bred from specially selected varieties - usually the parents breed pure to type, but are different from each other. Hybrids may be totally different from the original parents, or combine recognisable qualities of both of them. The seed saved from F1 and F2 varieties is often inferior and gives unpredictable results.

Annuals that have not been highly bred are often the most successful when grown from your own seed. Mixtures of annuals, such as poppies and pot marigolds (calendulas), can be relied upon to give a good show, but don't be surprised if they too are slightly different from the parent plants.

Among the border perennials, rock plants, trees and shrubs, most of the true species will produce offspring like the parent plant, though growing trees and shrubs from seed takes many years.

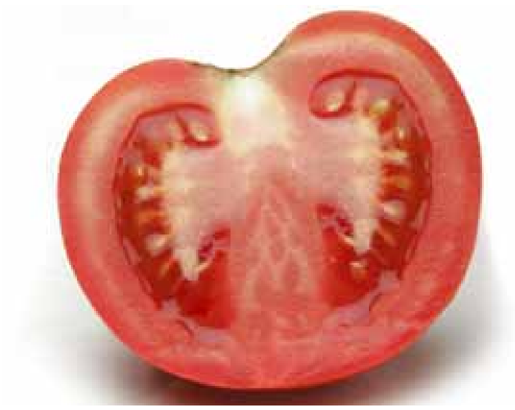
Highly bred species with many varieties and hybrids usually produce unpredictable results. This includes: aquilegas, dahlias, delphiniums, gladioli, roses and rhododendrons.

collecting seed

If you are collecting your own seed, the following guidelines apply:

- Pick the seed at the right time. This means leaving the seed on the plants for as long as possible. Some seeds are only fully ripe after shedding. When ripe the colour of the seed changes to a dark brown or black and the seed capsule texture changes.

- When drying, keep seed heads in paper bags - not polythene ones - hung up to dry. Spread large seeds such as marrow, pea and bean in paper-lined trays or boxes. Fleshy seeds such as tomato, marrow and cucumber should be washed to remove the pulp and then spread on blotting paper or kitchen towelling. Store pods and capsules in a warm dry place until they split.



- When dry, separate seeds from the pods or rest of the plant by shaking or blowing gently. Ripe seed can often be collected directly in envelopes or small containers simply by pressing the seed head between the fingers to release the seeds. Otherwise cut the stems and leave them on a tray in a warm, airy place, perhaps on a windowsill, until the seeds fall out. It is important to dry seeds naturally in a well-ventilated atmosphere, not in the oven.

- Seeds embedded in berries can be extracted by squashing the berries between fingers and thumb once they have become soft, then rinsing the seeds free in warm water.

- A few seeds, such as primulas and meconopsis, are best sown soon after collection, but many can be stored for a year or two if they are kept in a suitable container. For short term storage, paper bags kept in an airtight tin are adequate, but if you have a lot of seeds screw top jars are better. Tree seeds such as acorns and chestnuts should not be allowed to dry out so store them in damp peat.

- Label all seeds carefully with name, variety and date of collection. Store them in a dry, darkened and well-ventilated area at a temperature of 1 - 51C.

Before sowing your seeds you might wish to test them for germination. To do this place ten seeds on damp kitchen paper and keep warm and moist. After three weeks count the number that have germinated. If there are fewer than five then it might not be worth sowing that sample.

Whichever seed you use, your eventual results will depend on a range of factors, including the climate in your garden and the variety chosen. However, some seeds are naturally slow to grow or erratic. Flexibility is the key here - if one technique does not give you the results you want then try a different approach the next year.

buying seeds

There are a bewildering array of seed catalogues to choose from, and it is possible to grow a huge variety of plants from seed. To add to the confusion, many seeds have also been treated in some way - this is especially likely with seeds that are small and difficult to handle, or do not germinate reliably. There are three main types of treatment:

- **Chitted (pre-germinated) seeds** - these are usually used for popular plants that are difficult to germinate unless you are able to maintain a suitable temperature. Cucumbers are often sold in this way. The seeds are usually pre-germinated on trays of nutrient gel, supplying all the moisture and nutrients required. They will usually be delivered in a sealed plastic container, still on the gel. Such seeds need to be delivered promptly and planted immediately on arrival as the root will already have emerged from the seed. The supplier will give more specific instructions depending on the seeds ordered.

- **Primed seeds** - these are seeds that have been stored and treated to bring them to the point where they are ready to germinate. Any inbuilt dormancy will have been broken, so you should have seeds that germinate faster and more evenly. However, research has shown that non-primed seed quickly catches up - an interesting point as primed seeds are generally much more expensive than untreated seeds.

- **Coated or pelleted seeds** - these seeds are coated with a material that makes them larger, so they are easier to handle and to space out evenly when sowing them. (Another way of doing this is to mix them thoroughly with fine silver sand.) Sometimes the coating also contains a fungicide or nutrients. It is essential to keep the compost around pelleted seeds moist in order for them to germinate successfully.

- **Tapes and gels.** It is also possible to buy soluble tapes which have precisely spaced seeds embedded in an organic, water-soluble material. When planted, the tape dissolves and the seeds germinate normally. Seed tapes are especially convenient for tiny, hard-to-handle seeds. However, tapes are much more expensive per seed. Seed tapes allow uniform emergence of seedlings, eliminate overcrowding and permit sowing in perfectly straight rows. The tapes can be cut at any point for multiple row plantings, and thinning is rarely necessary.

  Organic gels contain an even distribution of seeds, and are quite paste like. They can be squeezed into the drills. (This is sometimes known as **fluid sowing**.)

Seeds may also be treated to kill harmful pathogens such as bacteria, fungus and viruses.

- **Hot water treatment**. This controls many seed-borne diseases by using temperatures hot enough to kill the organism but not quite hot enough to kill the seed. It must be carefully and accurately done. A few degrees cooler or hotter than recommended may not control the disease or may kill the seed.

  Hot water treatment is not suitable for all seeds. It can be damaging or not practical for seeds of peas, beans, cucumbers, lettuce, sweet corn, beets and some other crops.

  Hot water treatment of fresh seed should not reduce germination rates. However, treating old, out-of-date seed can reduce germination significantly. Once seed has been treated in this way it should be planted as soon as it is dry. Treated seed should not be stored as the hot water treatment many have weakened the seed coat.

- **Fungicide dusting** - Fungicides are often dusted on to seed to provide a thin protective layer. These treatments can prevent attack by fungi carried on the seed itself or in the soil around the seed. Diseases that attack germinating seeds and seedlings include damping-off caused by *Pythium*, and wire-stem (*Rhizoctonia solani*). As well as these seedling diseases, other problems that can become evident on more mature plants may also be controlled by dusting.

The majority of seed available for sale is F1 hybrid, which as you will remember is the first generation of offspring from two pure-bred, but different parents. F1 hybrids are preferred because they give a consistent appearance and quality, and also benefit from hybrid vigour. However, they tend to be more expensive than standard seed.

Many seed companies now also sell seedlings and plugs. These are more expensive than seed, but are ideal if you have no facilities for growing from seed or you are short of time. Again, these plants are usually F1 hybrids.

- **Seedlings** - These are supplied at a stage where they are ready to be pricked out. They are usually sold in quantities of 100 - 250.

- **Plugs** - These are larger than seedlings and are provided in their own secure 'plug' of compost. Plugs have a better root system than seedlings and are less vulnerable to damage, but they also tend to be more expensive. They are usually sold in quantities of around 25 - 50.

dormancy

The seeds of many plants have inbuilt mechanisms to control the time of germination; for instance, many seeds do not germinate in late autumn when conditions are unfavourable for seedling growth, but remain **dormant** until the temperature and other factors are more suitable.

Dormancy is achieved by a variety of mechanisms. In some seeds chemical inhibitors are present which stop the seed from germinating, but are broken down slowly over time or when a particular temperature is reached. Other seeds have a hardened coat that must rot or split in some way before the seed can germinate, and yet others need to experience alternate periods of high and low temperatures.

Some seeds are not truly dormant - they are ready to sprout, as soon as they receive some **moisture** and the **temperature** is warm enough. Vegetable seeds are a good example here.

thick seed coat

As noted, some seeds have very thick seed coats. These work by stopping water from reaching the embryo and activating its metabolism. Tough seed coats can be difficult to break through and horticulturists often use a process called **scarification** to nick the thick seed coat and trigger germination. We look at some ways of doing this later in the module.

In nature, thick seed coats may begin to break down as they age or they may gradually be worn away by abrasion (for example, some of the sea beans have thick coats which are gradually worn away as the large seed is washed against rocks and flotsam by the tide). Another very common way for a seed coat to be scarified in nature can be seen in fruits such as strawberry and raspberry. The thick seed coat is designed to be swallowed by a bird or animal. The creature digests the fruit pulp, but the seed coat passes through the digestive system still protecting the viable embryo inside. It is weakened enough by the digestive process to allow germination to begin. As an added bonus for the seed, it is deposited within a pile of natural nutrient-rich manure!

thin seed coat

Some seeds have a very thin seed coat, which provides an inadequate barrier to water. These seeds rely on alternative dormancy mechanisms.

One of the most common mechanisms relies on a pigment molecule called phytochrome which is found in some embryos. This pigment can absorb light and cause a change in the behaviour of the embryo. Phytochrome exists in two interchangeable forms. One form of phytochrome, named Pfr, is the form found in plant cells that are exposed to red (660 nm) or common white light. This form of phytochrome is biologically very active and plays a role in all systems when a plant needs to know if the lights are 'on' or 'off'. In lettuce (*Lactuca sativa*) seeds, Pfr causes the seeds to begin to germinate. Thus lettuce seeds germinate only when placed in white or red light. Buried in deep soil, they will not germinate. Given that lettuce has a small seed, this is an effective dormancy mechanism, stopping the seeds from germinating when they are deep in the soil and could not hope to survive.

The other form of phytochrome, named Pr, is formed when phytochrome is exposed to far-red (730 nm) light. This form is biologically inactive or inhibits responses. Thus if lettuce seeds are placed in far-red light they do not germinate.

insufficient development

If an embryo is not completely developed, some additional maturation may be needed before the seed can germinate. This is common in seeds that have very little space for food storage, e.g. orchids. These seeds may be so small that they are difficult to see with the naked eye and contain only a tiny, immature embryo. Orchid seeds form an association with fungi in the soil and this feeds the embryo until it is mature enough to break out of the seed coat. Seeds containing immature embryos generally have a very short period of viability and the fungal association must be established rapidly or the embryo dies.

chemical inhibitors

Many seeds contain chemicals that inhibit the development of embryos.

abscisic acid

Many temperate zone species rely on abscisic acid as an inhibitor. This chemical induces dormancy in the embryo. The chemical is produced in abundance in the late summer and early autumn (when it is also involved in leaf fall). By the time the seeds disperse they also contain high levels of abscisic acid, so they are unable to germinate. Over winter enzymes in the seed degrade the abscisic acid so that by spring most of it has gone and the embryo is able to germinate.

These seeds can be induced to germinate more quickly by a period of intense cold treatment, known as **stratification**, which we shall be discussing below.

phenolic compounds

In hot, dry climates there is no winter period so a different strategy has evolved. This relies not on abscisic acid but on phenolic compounds, which are potent, natural toxins. In a hot dry climate the seed does not want to germinate until the wet season, and this is precisely what phenolic compounds allow. As long as they are present in the seed it does not germinate, however, once the rains arrive the seed quickly begins to absorb water. The phenolic compounds, which are water-soluble, are leached out of the seed allowing germination to begin.

pre-sowing treatments

Horticulturists can use a range of techniques to overcome natural dormancy and ensure that their seeds will germinate more quickly. These treatments are often known as pre-sowing treatments.

If you have seeds that will require some pre-sowing treatment, forward planning is important, as some of these treatments can take several weeks to complete. Shrub and tree seeds, in particular, often require a prolonged cold period. Your supplier will be able to give you precise advice.

Pre-sowing treatments can be divided into two main types - scarification and stratification.

Seed scarification involves breaking, scratching, or softening the seed coat so that water can enter and begin the germination process. The seed will not germinate until the seed coat is altered physically. Stratification involves chemical or other changes within the embryo itself.

There is some misunderstanding about these terms, so it is worth taking a moment to clarify the difference between them: Scarification involves changes in the seed coat however these are made. Stratification involves internal changes within the embryo.

It is not the way the seed is treated that determines the name of the process but the changes it causes in the seed.

Seeds of some species exhibit what is known as double dormancy. This is a combination of seed coat (external dormancy) and internal dormancy.

To achieve germination with seeds having double dormancy, the seeds must first be scarified and then stratified for the appropriate length of time. If the treatments are administered in reverse order, the seeds will not germinate. After these treatments, sow the seeds under the proper environmental conditions for germination.

more on scarification

Scarification then involves any process of breaking, scratching, or mechanically altering the seed coat to make it permeable to water and gases. In nature, this often occurs by autumn seeding. Freezing temperatures or microbial activities modify the seed coat during the winter. Scarification can also occur as seeds pass through the digestive tract of various animals. There are several methods of scarifying seeds artificially, many of which replicate the natural processes in some way.

In acid scarification, seeds are put in a glass container and covered with concentrated sulphuric acid. The seeds are gently stirred and allowed to soak from 10 minutes to several hours, depending on the hardness of the seed coat. When the seed coat has become thin, the seeds can be removed, washed, and planted.

Another scarification method is mechanical. Seeds are filed with a metal file, rubbed with sandpaper, or cracked with a hammer to weaken the seed coat. Hot water scarification involves putting the seed into hot water (170^{o} to 212^{o}F). The seeds are allowed to soak in the water, as it cools, for 12 to 24 hours and then planted. A fourth method is one of warm, moist scarification. In this case, seeds are stored in non-sterile, warm, damp containers where the seed coat will be broken down by decay over several months.

Following scarification, the seeds should be dull in appearance, but not deeply pitted or cracked as to damage the embryo. Scarified seeds do not store well and should be planted as soon as possible after treatment.

more on stratification

As noted above, the second type of imposed dormancy found in seeds is internal dormancy regulated by the inner seed tissues. This dormancy prevents seed of many species from germinating when environmental conditions are not favourable for survival of the seedlings. There are several different degrees or types of internal dormancy. One type of internal dormancy is 'shallow' and simply disappears with dry storage. Many vegetable seeds display this type of dormancy. No special treatments are necessary to overcome this kind of dormancy.

However, another type of internal dormancy requires special treatments to overcome. Seeds having this type of dormancy will not germinate until subjected to a particular duration of moist-prechilling and/or moist-warm periods.

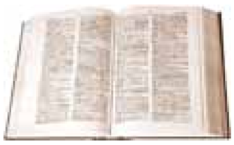
Seeds of some autumn-ripening trees and shrubs of the temperate zone will not germinate unless chilled underground as they overwinter. This so called 'after-ripening' may be accomplished artificially by a practice called stratification.

Cold stratification (moist-prechilling) involves mixing seeds with an equal volume of a moist medium (sand or peat, for example) in a closed container and storing them in a refrigerator (approximately 40^{o}F). Periodically, check to see that the medium is moist but not wet.

The following procedure is usually successful. Put sand or vermiculite in a clay pot to about 1 inch from the top. Place the seeds on top of the medium and cover with 1/2 inch of sand or vermiculite. Wet the medium thoroughly and allow excess water to drain through the hole in the pot. Place the pot containing the moist medium and seeds in a plastic bag and seal. Place the bag in a refrigerator. Periodically check to see that the medium is moist, but not wet. Additional water will probably not be necessary. After 10 to 12 weeks, remove the bag from the refrigerator. Take the pot out and set it in a warm place in the house. Water often enough to keep the medium moist. Soon the seedlings should emerge. When the young plants are about 3 inches tall, transplant them into pots to grow until time for setting outside.

Another procedure that is usually successful uses sphagnum moss or peat moss. Wet the moss thoroughly, then squeeze out the excess water with your hands. Mix seed with the sphagnum or peat and place in a plastic bag. Seal the bag and put it in a refrigerator. Check periodically. If there is condensation on the inside of the bag, the process will probably be successful. After 10 to 12 weeks remove the bag from the refrigerator. Plant the seeds in pots to germinate and grow. Handle seeds carefully. Often the small roots and shoots are emerging at the end of the stratification period. Care must be taken not to break these off. Temperatures in the range of 35^{o} to 45^{o}F (2^{o} to 7^{o}C) are effective. Most refrigerators operate in this range. Seeds of most fruit and nut trees can be successfully germinated by these procedures. Seeds of peaches should be removed from the hard pit. Care must be taken when cracking the pits. Any injury to the seed itself can be an entry path for disease organisms.

The length of time it takes to break dormancy varies with particular species; check reference books to determine the recommended amount of time. This type of dormancy may be satisfied naturally if seeds are sown outdoors in the autumn. Warm stratification is similar except temperatures are maintained at 68ºF to 86ºF, depending on the species.



Read Chapter 7 of *Principles of Horticulture* from page 62, *'The Seed',* to *'The Vegetative Plant*', on page 67, which summarises the ideas explored so far and also introduces some of the subjects we shall be exploring next.

seed quality

When we select seed, we are looking for high quality seeds that will give, as far as possible: synchronised germination, uniform crop characteristics (e.g. same height) and healthy vigorous growth.

As noted in your textbook, The Seed Acts govern the quality of seed. For edible crops and forest trees, testing is monitored by the International Soil Testing Association. Characteristics that are assessed under these testing procedures include:

- **Purity** - the percentage of undamaged seed
- **Germination** - percentage of viable seed
- **Health** - presence of potential pathogens or weed seeds.

Flower seeds are not covered by the act.

The germination percentage (**viability**) of seed varies depending on environmental conditions - for instance, more seed is likely to germinate in a dry, warm, sheltered site, than on a damp, cold moorland site. This variation in performance is known as **vigour** - a property regulated by the **Vigour Test Committee** of the International Seed Testing Association.

In selecting seed for horticultural purposes, the buyer needs to be sure that the seed has good viability and vigour.

key terms

Viable - a viable seed is one that still has the ability to germinate. In general, the older a seed, the less likely it is to be alive. Seed selected from old stock will thus have a lower viability than new stock.

Vigour - this is the seeds ability to germinate and develop into a healthy seedling under a wide range of simulated field conditions.

Note, in the UK most types of agricultural seed cannot be sold unless it has been officially certified.)

Precise definitions of 'purity' and seed health vary between countries, but the following features are most common:

Germination - Germination is one of the most important aspects of seed quality and low germination is one of the most common causes of poor quality in seed. When seeds are analysed for germination, the tester will consider a number of features. They are trained to recognise seedling abnormalities caused by disease, drying, and mechanical and sprouting damage, and can thus give a reliable estimate of seed's potential to develop into plants in the field.

Conducting germination tests on seeds can be time consuming so a widely used alternative method us the tetrazolium test, which is a chemical test.

The tetrazolium test can give a very reliable estimate of potential germination in less than 24 hours. The test can be used to test any seed that can be bisected (cut in half).

Seed embryos contain enzymes which are responsible for controlling germination. These enzymes react with a colourless 1% triphenyl tetrazolium chloride solution to produce a vivid red stain. Seeds that will germinate normally are stained all over the embryo. The more enzymes that are present, the brighter and stronger the red stain, and this is a direct indication of germination potential.

Damage during drying is one of the principal causes of low germination in many crops and the tetrazolium test can indicate whether drying damage has occurred.

Other test, specific to a particular crop, many also be used. A pea test, for example, has been developed and is based on the concentration of salts released from the seed into a sample of water, which is then tested for electrical conductivity.

Similarly, a carrot vigour test involves measuring the seed embryo length and recording variation within a lot. The higher the level of uniformity the better the germination rate. The quality of lettuce crops may be predicted in a similar fashion by using a slant board test to measure seedling root length.

Exposing vegetable seeds, under controlled conditions, to the two most important variables that influence deterioration can test the viability of most vegetable seed types. The deterioration test is an ageing technique that records the germination potential of seed before and then after treatment at high temperature and moisture. The resultant vigour comparison gives an indication of likely storage potential and eventual field performance of particular seeds.

Seed purity - A purity test provides information on the composition of a seed sample and gives details of the contaminants, for instance, with weed or other crop seeds, or with fungal infections.

Seed purity tests usually determine the percentage weight of seeds in the sample under examination which is true to type and is genuine **seed** of the kind named. It does not assess varietal purity, which can be only be obtained by growing the **seed** to maturity.

To determine purity the tester examines the sample **seed** by **seed**, under a microscope if necessary. All normal seeds of the desired species are segregated from the various impurities, and weighed to determine the percentage purity of the **seed** sample. Impurities in a sample usually consist of:

- weed seeds
- other crop seeds (e.g. carrot in a lettuce sample)
- inert matter (e.g. broken grain, soil, scraps)
- for grasses, seeds which contain no kernel (caryopsis), or contain only an undeveloped kernel - these are regarded as inert matter.

Seed health - Seed-borne diseases can seriously affect the quality of certified seed. In certification schemes disease is usually controlled during seed production by using appropriate chemical seed treatments. Seed-borne diseases can multiply rapidly from one generation to the next and seed crops can also become infected from neighbouring, diseased fields.

In some circumstances, the choice of seed treatment may depend on the results of tests for seed-borne diseases. A loose smut test can determine the incidence of smut infection in certified or farm-saved wheat or barley and a barley leaf stripe test will determine whether infection is present. The results of these tests can be used to decide upon to control measures and seed treatment strategies.

For instance, germination and emergence can be reduced in field peas and beans by seed-borne *Ascochyta* infection that can also spread and cause disease in other crops. Seed treatments to control *Ascochyta* are more expensive than conventional protectant fungicides. An *Ascochyta test* will determine whether infection is present and aid seed treatment decisions.

Moisture content - This is a key factor in determining seed storage potential and can also influence germination after chemical treatment.

provenance

This refers to original source of seed - where it came from specifically - seed collected outside of its natural range may not be as well adapted as seed collected from nearby sources. Although seedlings may belong to the same species, those from different climatic regions may be very different from each other in physiological terms; for instance, plants originating in the south of England will typically be less cold-hard and have a quite different photoperiod response to plants of the same species that originate from northern England or Scotland. This can lead to problems of cold hardiness if plants are transferred from, for example, Southern to Northern England. Such problems are becoming increasingly common with the rise of Internet nurseries, where growers can easily order seed from anywhere in the country. Because of the potential for problems of this type, it is important to know the origins of a plant.

legislation

The Plant Varieties and Seed Act 1964 - Part II of the Act provides for the power to regulate and amend in other respects the law relating to transactions in seeds, including the provision for the testing of seeds. To control the import of seed and authorise measures to prevent the injurious cross-pollination of seeds.

Seed Marketing (England) Regulations 2002 - The marketing of seed of the main agricultural and vegetable species in England is regulated by the Seed Marketing Regulations. The Regulations define the species covered and the standards that the crop and seed must achieve before crops and seed can be certified and marketed. The certification process places the onus on the applicant to make decisions about their crop and seed and is based on a three building block approach.

A variety must be listed on a National List or in the EU Common Catalogue, in accordance with the Seeds (National Lists of Varieties) Regulations 2001.

- A satisfactory crop report must have been lodged.
- A satisfactory seed test report must have been lodged.
- Uncertified and unlisted seed of these species can only be marketed in accordance with specific exemptions, which are set out in the Seed Marketing Regulations and with prior written authorisation from a