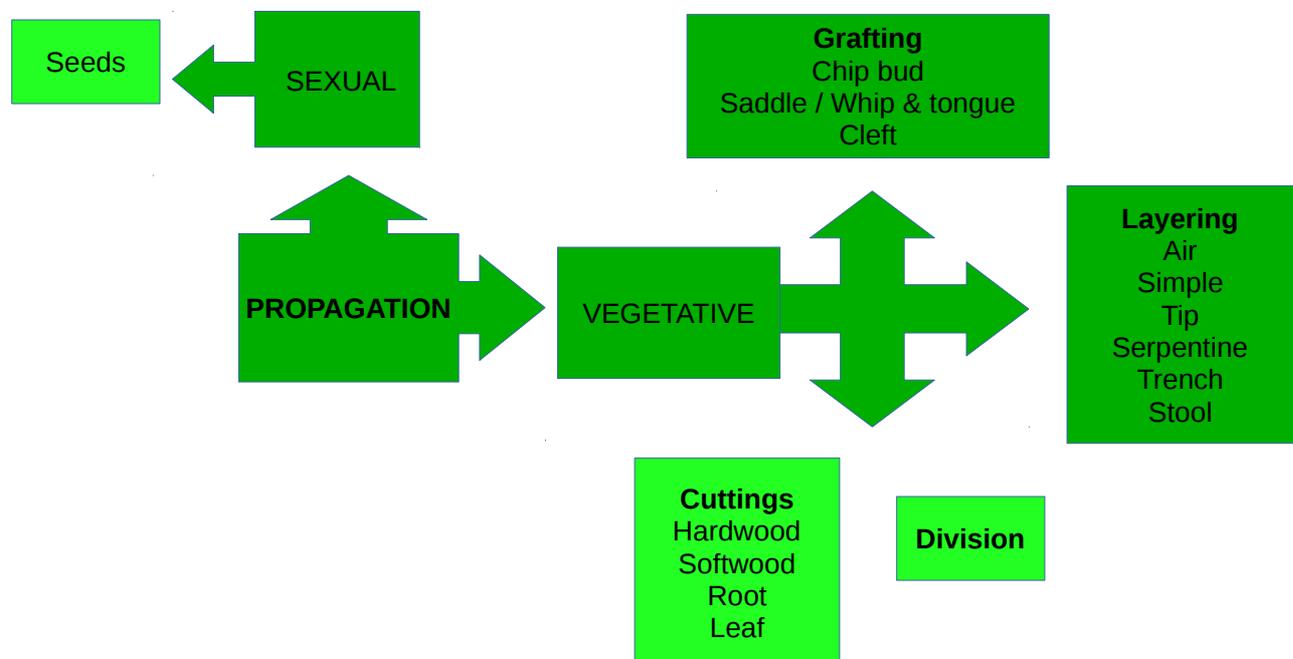


# Plant Propagation: course notes

## Unit title: Developing Plant Propagation Skills

- 2.1 Explain the advantages of using seed in plant propagation.
  - 2.2 Explain the disadvantages of using seed in plant propagation.
  - 2.3 List the types of seed available
  - 2.4.State the advantages and disadvantages of using different sources of seed
  - 2.5 Illustrate how to harvest a batch of seed
  - 2.6 Record its provenance.
  - 2.7 Sow seed in media and containers
- 
- 3.1 List plants suitable for propagation by cuttings
  - 3.2 List plants suitable for division
  - 3.3 Describe the main treatments that may be used to maximise chances of successful rooting.
  - 3.4 Explain the factors that need to be taken into account when selecting appropriate media for successful propagation by cuttings.

Vegetative propagation is cloning. Sexual propagation involves mixing the genetic material of two parent plants. Different methods are suitable for different plants.



# Seeds: advantages and disadvantages of sowing by seed instead of other propagation methods

## Advantages

seeds can be stored for a long period of time

## Disadvantages

planting and caring for seeds takes a lot of time

# Seeds: different types of seed available

Adapted from <http://www.betterhensandgardens.com/2012/04/22/garden-seeds-gmo-ge-op-heirloom-hybrid-whats-it-all-mean> along with the American spellings!

## OP (Open Pollinated)

Open pollinated seeds are those that are produced by pollination from wind, insects, or self-pollination. You can save seed from open-pollinated varieties and use them from year to year because they will produce plants that are essentially the same as the plants from which the seed was harvested. NB they are not clones, that's only achieved by vegetative propagation such as cuttings or division. They are often very similar to the parent plant because there is a limited gene pool available – but mutations and evolution do happen and plants do adapt to their local conditions. It is therefore useful to use open pollinated seeds that are of a 'known provenance' with growing conditions similar to your own. Open pollinated seed is usually less expensive than other seed types because no hybridization work has been done.

## Heirloom

These are open-pollinated varieties that have evolved over time through gardeners' selection process rather than by intentional hybridization. Some use 50 years (a variety needs to be at least that old) as the age that defines an heirloom while others define it as varieties developed prior to the 1940's. In the past, heirlooms were passed from generation to generation – but today can be purchased from commercial seed sources. Popular examples of heirloom varieties include Brandywine tomatoes, Lemon cucumbers and Kentucky Wonder pole beans. Since heirlooms are just "old" open-pollinated varieties, seeds can be saved from year to year and they're also usually less expensive than hybrid or other seed types.

## Hybrid

A hybrid (or F1) occurs when a breeder selects two open-pollinated types and cross pollinates them to obtain the best traits from the parents. Breeders typically hybridise to improve disease resistance, earliness, etc. Hybrid seed is usually more expensive than open-pollinated or heirloom seed because of the work involved producing the seeds, and seeds generally aren't saved from hybrid varieties because they won't produce plants with the same characteristics as the parents. Examples of hybrid varieties include Better Boy and Early Girl tomatoes or Sugar Ann snap peas. The only way for plant nurseries to sell seeds that give a predictable hybrid is by crossing two parent plants that are 'pure'. This can only happen by in-breeding plants for several generations until all the offspring show the desired trait for the parent plants. They then breed these with each other and sell their seeds. This practice wastes a lot of land and energy!

This paragraph is from <http://apps.rhs.org.uk/advice/search/Profile.aspx?pid=710>

F1 hybrids, which are largely annual and vegetable cultivars, are produced by crossing two stable seed lines (called inbred lines) that give rise to especially uniform progeny that possess good vigour, yield and other properties.

**Advantages of F1 hybrids:** 1) Greater uniformity of flowering, stature, yield and maturity period. Although uniformity is usually more valuable to commercial growers, hybrids usually offer worthwhile advantages to home gardeners over other forms of seeds. 2) Greater size and vigour of flowers or produce due to the phenomenon of hybrid vigour (heterosis). Hybrids are therefore more robust and better able to overcome adverse growing conditions. 3) Plant breeders benefit because they control the inbred lines. Therefore the hybrids they breed cannot be grown by other seed companies who lack the parent lines. Although this keeps costs of F1 hybrid seed high, it is an incentive for breeders to produce new and better cultivars, to the benefit of all growers

**Disadvantages of F1 hybrids:** 1) Seeds saved from F1 hybrid plants will not produce plants that are true to the parent type. 2) F1 hybrid seed is expensive as it has to be recreated by crossing the parent inbred lines again. Self pollination of the parent inbred lines leads to poor quality plants called 'selfs'. Preventing selfs is complicated and costly which also contributes to the expense of F1 hybrid seed. 3) Due to the cost of maintaining the inbred lines, quite a lot of seed has to be sold for a hybrid to be commercially viable. For this reason hybrids are often only offered for a few years before coming off the market leaving gardeners to seek a replacement for favourite cultivars. 4) Waste of land and energy in their production (this disadvantage is not listed on the rhs site!)

## GMO (Genetically Modified Organism)

There's lots of hype about seeds of this type, but the USDA defines it as any type of organism produced through the use of genetic modification. This means that whether produced by high-tech genetic engineering or by traditional plant breeding methods, the seeds are considered GMO. Plant breeders that select for traits like uniformity or disease resistance from open-pollinated varieties to obtain a hybrid cross are genetically modifying the organisms. Examples of GMO breeding include all the hybrids and higher-tech crosses like pluots.

## GE (Genetically Engineered)

Although GMO and GE are often used interchangeably by the media, it's the GE crops that are generally the real source of debate. Only through human manipulation can plants that are not sexually compatible be combined. Genetic engineering is the high-tech method of inserting genes directly into an organism to produce plants that could not be produced by nature. Example of GE seed includes Bt-corn and Roundup Ready corn, soybeans, cotton, and alfalfa.

The Safe Seed Pledge arose after the introduction of the first GE seed; and companies signing have pledged not to buy or sell genetically engineered seed. A list of companies signing the pledge is maintained by the Council for Responsible Genetics here: <http://www.councilforresponsiblegenetics.org/viewpage.aspx?pageid=261>

## Organic

This means that the land the seed was grown on cannot have had prohibited substances applied for three years prior, and that the farm must be managed in accordance with a plan that is approved and inspected by the certification body. Organic growers cannot use synthetic fertilizers or pesticides, and sewage sludge, irradiation, genetic engineering, and treating seed with fungicides are prohibited.

## Pelleted

These seeds are enclosed in an inert material to form a pellet; and the technique is usually used on very small seeds (like lettuce, carrots, etc.) to make them easier to handle. Pelleted seed is also sometimes "primed" meaning the seed has been processed to be just ready to germinate. Primed seed germinates very quickly but should be used in the year it's purchased because the priming process generally decreases storage life. Seed bombs are home-made pelleted seed mixtures that are wrapped in clay. When the soil is damp, the clay breaks down and the seeds have enough moisture to germinate.

## Treated

Treated seeds are usually coated with a fungicide to protect seed from pathogens when germinating in wet or cold soils. If considering a seed that's labelled as treated, it's necessary to check the packaging for the specific details about what's been used.

## Seeds: sowing

Seed sowing is form of sexual propagation. The genetic material of two parent plants has been combined to create seeds which contain the recipe for genetically unique offspring. When the seed grows into a plant it will not be a clone of the parent.

This section is adapted from: <https://www.rhs.org.uk/advice/profile?PID=206> Many vegetables, annuals, biennials and herbaceous plants can be grown from seed sown outdoors. The secret to success is to prepare a good seedbed, free of weeds and with a crumble-like soil-surface texture.

### Suitable for...

Many vegetables, annuals, biennials and herbaceous plants can be grown from seed outdoors. Good annuals: *Tropaeolum majus* (nasturtiums) and *Calendula* (pot marigold); good biennials: *Barbarea verna* (land cress) and *Oenothera biennis* (evening primrose); and good herbaceous plants: *Leucanthemum x superbum* (shasta daisy), *Tragopogon porrifolius* (salsify) and *Diploxys tenuifolia* (perennial rocket). Vegetables such as bean and peas can also be grown outside from seed.

Sowing seed outdoors, directly into final growing places, is ideal for gardeners who do not have much room to raise seed indoors in trays or propagators. You also don't need to start seed sowing as early in spring as when you sow outdoors. You can scatter seed of ornamentals in free drifts to achieve a natural-looking distribution, or sow vegetables and flowers in lines to simplify weeding and thinning.

### When to sow seed

As long as the soil is warm and moist, seed can be sown and it will germinate quickly. In practice, this usually means either mid-spring to early summer (April-June), or late summer (September). If you can provide the crop with protection, such as cloches or fleece, sowing can begin in early spring. Likewise, regular watering will make it possible to raise rows of seedlings in the height of summer. Always refer to the seed packet for the best time to sow, as it does vary with plant type.

### How to sow seed in an open bed

Sowing seed is very straight forward – just think of how many plants scatter their seeds and they grow where they land as soon as it is moist and warm. However, for the best success, this is the best way to sow:

- Beds should be dug over in advance to allow time for the soil to settle. New beds can benefit from but turning the soil over to a spade's depth is usually sufficient.
- Cover over the roughly dug bed with plastic or a double layer of fleece to suppress weeds and, in early spring, to help warm up the soil.
- At ELL (not from RHS site) we tried to cover the bed in transparent plastic to 'bring on' any weed seeds, the plan was that we'd then hoe them away. This is meant to help prevent weed seeds from germinating later on. We found that this didn't work entirely, but may be because we didn't check the soil often enough.
- When you are ready to sow, uncover the bed. Use a rake to level the surface and create a crumble-like tilth. Then pick off any remaining weed and debris. (NB at ELL we try to only disturb the soil once – when we dig it in Autumn)
- Place a cane or stake across the bed and lightly push it into the surface. This will create a straight drill (shallow depression) whose depth should be as directed on the seed packet. The drills should be spaced according to the instructions on the seed packet. (NB this is only if you WANT straight drills. Plants will be less stressed when given enough space and planted in a polyculture, but you'd need to be able to recognise the young seedlings.)
- Add water to the row before sowing. This is usually better than watering over the top of sown seeds which sends them all over the place.
- Thinly scatter the seed into the bottom of the drill. Don't be over enthusiastic, as plants will need thinning to the spacing recommended on the seed packet. A finger width apart is usually right for small seeds.
- Use a rake to gently cover the seeds with soil, filling the drill back in again.
- Before you forget where the row is and what you've sown, place a label in the soil at one end.
- Cover the patch with a single layer of fleece. Use a spade to push the edges of the fleece into the ground to ensure it doesn't blow away.
- Remember to water in dry spells. This means every day during a dry spring. Remember that any roots will only be a few millimetres long and will dry out.

## Problems

Packing down of certain soils under heavy rain can cause a cap of hard compacted soil that dries to a crust thorough which seeds can not emerge. Prevent this by covering seeds with potting media such as peat-free multipurpose compost.

Other problems include:

- Pigeons, squirrels and other birds can be a pest where seeds are not covered with fleece
- Occasionally, seedlings can fail to emerge, or keel over soon after emergence in wet weather. This is known as damping off.
- Likewise, slugs and snails eating young seedlings can be a problem

## Today we will be sowing...

In September and October the choice of seed you can sow is a bit more limited than at other times of year:

- *Diploxys tenuifolia* (rocket), *Malva sylvestris* (musk mallow) and *Lathyrus latifolius* (everlasting pea) can be sown in September. They are perennial plants and will come back every year.
- Any hardy annuals can be sown in September, e.g. *Tropaeolum majus* (nasturtiums), *Calendula* (pot marigold) *Lunaria annua* (honesty), *Papaver rhoeas* (opium poppy) and *Linum usitatissimum* (flax).
- Broad beans can be sown in October and November.

We'll also be sowing seeds into containers so you can take them home or put them in a more protected position in the garden. This is especially useful for plants that might get dug up and eaten, e.g. the everlasting peas.

## Seeds: collecting

From <http://www.realseeds.co.uk/> Seed that is air-dry is not really properly dormant - its just napping; so it is still burning through its stored reserves of energy and will soon run flat - like a mobile phone left on. Also, you can't put it in a sealed container as it is still breathing - it would suffocate. And without a sealed container, it will soon reabsorb water from the air on the first humid day, and start getting ready to germinate.

### How can we dry the seed at home?

We'll use dry rice to suck the water out of the seed & get it really dry. Then it will hibernate completely. You need to get:

- a big jam-jar with a good lid,
- an old pair of tights,
- a rubber band,
- and some rice

You need to use at least twice as much rice as you have seed. It doesn't matter if you have too much rice, but too little won't work.

Bake the rice on a tray in the oven for 45 minutes until it is bone dry. While it is still hot, put it in the jam-jar, about half full, and screw the lid on.

Wait patiently until the rice is cool. (If you rush this you'll cook your seeds.) So you now have a jam jar 1/2 full of very dry, cool rice.

Put your seed in a bag made by cutting off the foot of the tights, and tie it in with a rubber band. Put it in with the cool dry rice. Put the lid on tightly, so damp air can't get in.

Leave your seed sealed in the jar with the dry rice for a fortnight, and the dampness in the seed will be drawn out into the rice.

You now have bone-dry seed that you can safely seal in a plastic bag, and it will keep for several years.



### Passing it Round

This is also important. You will have huge amounts of seed. If you are sure you avoided crossing, and that your plants were nice and healthy, then you have a valuable thing there.

You will get about two and a half kilos of seed from a 20-foot-long bed of 30 plants. Now that's actually three-quarters of a million seeds - and if every one of those was given away or swapped, and then grown, you will have created more than 500,000 kilograms of kale! More than enough to feed all your friends and neighbours, and their families.

So you can see that even one person, on a small scale, can make a real contribution to local food security. Take your spare seed to a local seed swap, or even better, organise your own. Get together with your friends or family and set up a seed-circle: one person can grow kale seed, another parsnips, another cucumber, etc etc. You'll all have bags of seed - you can all just swap with each other, so no-one has to save seed from more than a couple of things, yet you all get seed of everything.

It will save you a fortune, and you'll get great, locally-adapted varieties. Just remember, all this is only possible because you are growing real, open-pollinated seed. You can't do this with hybrid (F1) varieties.

Funny how the seed companies are so keen on selling you hybrid seed, isn't it?

The way we do it at ELL is to collect seed heads and store them upside down in a paper bag until they've dried out. We then move them into a container which is stored outside or in a cold place.

**It's essential to label what the seed is and when it was collected.**

# Cuttings: hardwood cuttings

## Why?

A simple, easy, robust propagation technique.

## Which plants?

Willow is particularly easy. At ELL we're using HWC to propagate jostaberries, currants, fig, and grapevines. We're also going to try quince.

## When?

Any time during the dormant (winter) season. Best just after leaf-fall or just before spring growth. Can be combined with pruning.

## Where?

Put the cuttings in a pot or nursery bed in a cool, sheltered area with good drainage and without weed competition. It's important to avoid them drying out or rotting.

A large number of cuttings can be placed in a slit trench made with a spade, and lined with sand.

## What do you do?

Use vigorous new growth, of pencil thickness, about 15 - 25cm long. Cut it above and below a node. The base of the stem has greater rooting power. Remove any leaves. Rub off extra buds if you don't want a multi-stemmed plant. Bury at least  $\frac{2}{3}$  of the cutting beneath the soil.

The cuttings will have formed roots and be ready for transplanting in autumn of the following year.

Larger cuttings ('truncheons') can be used for fig or mulberry.

## Watch out:

Remember to check the cutting's the right way up! Grapevines can be tricky. When you see buds opening in spring, don't assume roots have developed yet

## Tips

Use willow or seaweed solution for extra hormonal stimulation.

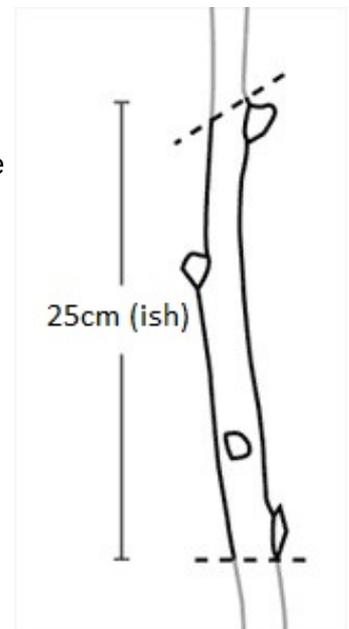
If you take cuttings often, keep a stock plant. Repeated cutting back will produce long vigorous shoots and will maintain it in the 'juvenile' phase, when it forms new roots more easily. (Hence our 'Mother bed'.)

Blackcurrants, redcurrants & whitecurrants are particularly easy to propagate from cuttings. With very little effort and space, you can take some every year, and fill London with currant bushes...

## Tools

Secateurs. Keep them sharp and clean.

Labels. Have them ready before you start.



## Cuttings: root cuttings

Adapted from the RHS website: Some plants, both herbaceous and woody, readily produce shoots direct from their roots as a natural process, particularly at a point where damage has occurred. Consequently, pieces of severed root can be used as cuttings. Root cuttings require less attention than semi-hardwood or softwood cuttings. Root cuttings can be used to propagate a range of herbaceous perennials in late autumn or early winter when the plants are dormant.

### Suitable for:

Root cuttings are used to propagate plants that naturally produce suckers (new shoots) from their roots. Good ones to try: *A Armoracia rusticana* (horseradish), *Symphytum grandiflorum* (creeping comfrey), *Mentha spp.* (Mint) and *Myrrhis odorata* (sweet cicely). Root cuttings require no special aftercare, large numbers of new plants can be generated from each parent plant, and the plants derived from root cuttings are relatively large and vigorous. They tend to be taken in the quiet season in winter when gardeners' hands are not as full as in summer. Another bonus is that plants from root cuttings are free of foliar pests and pathogens that might affect their parents, such as stem and leaf nematodes. Herbaceous plants that take well from root cuttings often have thick or fleshy roots.

### When to take root cuttings:

Root cuttings are best taken in mid- to late autumn or early winter when plants are dormant.

### How to take root cuttings:

Choose vigorous clumps to propagate. Lift the plant when dormant which is usually in late autumn or winter, and wash the roots. (NB at ELL we don't wash the roots.)

- Select young, vigorous pencil thick roots and cut them off close to the crown with a sharp knife or secateurs.
- Remove no more than one-third of the root system from the parent plant, and replant the parent plant as soon as possible.
- Discard the thin root end and remove any fibrous lateral roots.
- Cut each root into 5-10cm (2-4in) lengths making a horizontal cut at the upper end and an angled cut at the lower end, so you can tell which way is top and bottom.
- Fill pots with a cuttings/potting compost, such as equal parts peat substitute and gritty sand or perlite.
- Insert cuttings about 4cm (2in) apart so that the horizontal cut surface at the top of the root is just below the surface of the compost and top dress with a 1cm layer of grit.
- Water the compost lightly and place the pots in a cold frame.
- The following spring, pot up individually when the cuttings show signs of growth and are well rooted. Grow plants on and plant out the following spring.

### Choosing roots

Many perennials, *Humulus lupulus* (hops) and *Rubus fruticosus* (blackberry) have thinner roots. Root cuttings should contain enough food reserves (carbohydrates) to ensure survival and regeneration; thin-rooted species therefore require longer root sections of 7.5-12.5cm (3-5in). Lay these horizontally, 2.5cm (1in) apart, cover with 1cm (3/8in) of compost and topdress with grit.

For root cuttings of woody plants carefully dig down to expose part of the root system. Take roots up to finger thickness. Remove any fibrous roots and cut into 5-15cm (2-6in) sections. Then treat in the same way as root cuttings of herbaceous plants. Root cuttings cannot be used to propagate variegated plants as the new plants will have plain leaves.

### Problems

No roots to propagate from: Good roots can be obtained from older plants by lifting them in autumn and trimming top and root growth to within 5–10cm (2-4in) of the crown. Replant in prepared soil to encourage young, vigorous roots for propagating the following autumn.

Plants resenting disturbance: Some plants have long taproots and resent root disturbance. Carefully dig down the side of these plants to access a few roots. Alternatively, in spring, place containerised plants on a 15cm (6in) layer of sand in a box and sever the roots produced in the sand in autumn for use as cuttings.

Preventing rot: Until root cuttings are growing strongly and well-rooted take great care not to over-water.

Below are a couple of You Tube demos on propagating by root cuttings:

[http://www.youtube.com/watch?v=Fj8m\\_uU2WoQ](http://www.youtube.com/watch?v=Fj8m_uU2WoQ)

<http://www.youtube.com/watch?v=8gwCLs8LoTs>

## Division

Adapted from the RHS advice section. Dividing perennials regularly will ensure healthy, vigorous plants that will continue to perform year after year. It also offers the opportunity to multiply your plants. It can be done with young perennials, tuberous plants, plants with rhizomes, some shrubs and tree suckers.

### Suitable for:

*Allium cepa proliferum* (tree onion), *Allium schoenoprasum* (chives), *Centranthus ruber* (red valerian), *Diploaxis tenuifolia* (perennial rocket), *Gladiolus dalenii* (Gladiolus), *Hemerocallis fulva* (day lily), *Leucanthemum x superbum 'Becky'* (shasta daisy), *Rumex acetosa* (polish sorrel), *Viola riviniana* (violet), *Tilia cordata* (small leaved lime).

### When to divide perennials:

Plants can be divided successfully at almost any time if they are kept well-watered afterwards. However, division is most successful when the plants are not in active growth.

- Divide summer-flowering plants in spring or autumn when the soil is dry enough to work. In wet autumns, delay until spring. Spring is also better suited to plants that are a touch tender
- Many spring-flowering plants, such as irises, are best divided in summer after flowering when they produce new roots

### How to divide perennials

Here are our simple tips for dividing perennials.

- Lift plants gently with a garden fork, working outwards from the crown's centre to limit root damage. Shake off excess soil so that roots are clearly visible
- Some plants, such as polish sorrel, produce individual plantlets which can simply be teased out and replanted.
- Small, fibrous-rooted plants such as violets can be lifted and pulled apart gently. This should produce small clumps for replanting
- Large, fibrous-rooted perennials, such as *Hemerocallis* (day lily), require two garden forks inserted into the crown back-to-back. Use these as levers to loosen and break the root mass into two sections. Further division can then take place
- In some cases, a sharp knife, axe or lawn edging iron may be needed to cleave the clump in two
- Plants with woody crowns such as *Rheum sp.* (rhubarb) or fleshy roots (e.g. *Delphinium*) require cutting with a spade or knife. Aim to produce clumps containing three to five healthy shoots

### Aftercare:

Plant divisions as soon as possible and water them in well. Alternatively pot up individually to build up size, overwintering pots in a frost-free environment.

There isn't much on YouTube to demonstrate propagation by division but here is a demo that's quite useful to show the basic principles, even though the plant used is a carnivorous pot plant;

<http://www.youtube.com/watch?v=OYoBDGsR1fs>