Propagation of New Zealand native plants

Jill Broome[1]

INTRODUCTION

Propagation is the practice of producing plants from the parent stock, either by cuttings (which will produce clones genetically identical to the parent) or seed and spores (which will produce offspring genetically different to the parents). Nature has managed this since the beginning of time, by distributing seed or spores, producing offshoots, and layering naturally. Growers get a certain spark in their eye when discovering that they have managed to grow a very rare or hard to propagate plant (Fig. 1), even if it takes a year or two to get to the seedling stage. This article summarises what I have learnt from ten years of propagating plants at Percy Scenic Reserve.

Figure 1. Seedlings of the Nationally Critical *Olearia gardneri* from Paengaroa Scientific Reserve.

1 Plant Collections Supervisor, Percy Scenic Reserve. Downer, PO Box 50-465, Porirua, Wellington

STERILISING MEDIA

For successful propagation, hygiene is one of the most important factors. Plant material may become infected with disease spread from unclean tools, possibly by spores of fungus or bacteria. Cuttings should be free of disease which may spread to other plant material causing dieback and collapse. Thoroughly clean hands and tools, and use sharp knives or secateurs. Use sterile mixes and potting media. A general cleanup once a month will eliminate most pests and disease.

Growing media can be sterilised by heating. Small amounts of *Sphagnum* moss and peat, mixed with water to make it sloppy, can be sterilised in microwave, at full power for 15 minutes. Or otherwise heat in a conventional oven: first moisten the mix (*Sphagnum* and/or potting mix), and then cook for 30 minutes at 100°C covered with foil. Alternatively, boiling water can be used: put mix into an ice cream container with holes in the bottom. Then pour boiling water over, cover and allow it to drain. When it cools, it is ready to use.

SEEDS

The ripening ovary of a flowering plant contains one or more seeds such as the dry fruit like the poppy, or fleshy like the peach. The fruit of plants can be any of the following: achene, berry, capsule, caryopsis, cocci, cypsela, drupe, follicle, legume, lomentum, nut, pome, samara, silique. This list is not comprehensive; there are plenty more names for fruit. They come in all shapes and forms (Fig. 2) and often have hard to pronounce names: caryopsis (of grasses) is the pericarp fused to the seed coat; cocci in Euphorbiaceae; lomentum is the pod of the legume; pome is the receptacle of the apple enclosing the ovary and seeds; samara is a wing like extension for dispersal (akeake, houhere); siliques are long dry dehiscent fruits (of cruciferous plants).

Figure 2. Seeds of *Aciphylla squarrosa*, *Dracophyllum strictum*, *Podocarpus nivalis* and *Lepidium oleraceum*.

When raspberries and blackberries rot on the ground, they provide humus for young seedlings. *Beilschmiedia tawa* and *B. tarairi* are both eaten by the native pigeon, kererū or *Hemiphaga novae-zelandiae*, and then deposited creating a wide range of dispersal. Kererū also like the fruit of pigeonwood, *Hedycarya arborea.*

SEED CARE AND BIOLOGY

After collecting, the seed needs to be processed. Keep the seed dry to avoid fungal infection (especially for monocots.). In nature, some seeds can survive freezing temperatures or drought conditions that normally kill the parent plant. Low temperature storage is used in seed banks to prolong the life of seeds. Seeds from fleshy fruit need to be thoroughly washed and dried before sowing (e.g., *Melicytus* spp.).

Stratification involves placing the seed in damp seed raising mix somewhere warm for a few days then refrigerating for up to four weeks. The seed is soaked for a few days in water, and then it may be stored in the refrigerator for a specific period prior to sowing. Place seed between two layers of moist paper (e.g., paper towels, coffee filters) in the fridge or in damp gritty sand in a container or bag in the fridge. Some seed may be stored for longer periods in the refrigerator if kept dry. A seed has less than 2% water for its weight. If it becomes completely dry it becomes unviable.

A seed has all the reserve materials to support the seedling until it can gather nourishment for itself. All seeds contain protein to supply nitrogen and either carbohydrate or oil to supply energy. The carbohydrate, as in the pea, bean and most cereals, is chiefly starch. Rye has a good deal of sugar enclosed in the seed and the castor bean seed has oil instead of starch. The date seed endosperm is cellulose.

Some seeds have a period of after-ripening, which means the seed will continue to mature if kept in its natural container to protect the seed from premature germination, usually by coating the seed with chemical inhibitors. The embryo will then mature and the seed coat harden.

Seed coat thicknesses, colour and texture vary from species to species. The thickness and hardness of the seed coat determines how fast water can penetrate it. This in turn determines how soon germination will take place after seeds have naturally worked their way into the soil with the aid of rainfall and gravity. Naturally occurring chemicals in seed coats can hinder germination. These chemicals need to be washed away by heavy rain. Summer showers have little effect on leaching away the chemicals. Scarification involves wounding the seed coat to allow penetration of water.

GERMINATION

Not all seeds germinate at once (Fig. 3). While annoying to the grower, nature has staggered germination over several months or years which is advantageous for the survival of the species.

Figure 3. Pots with seed (some with mossy pads) awaiting germination.

Seed germination requires moisture, oxygen and warmth (but not light). Optimum temperatures are 10–42°C (40–115°F). Seeds absorb water by a process called imbibition, in which water molecules fit into the spaces between cellulose, proteins and other substances in the dry cell walls and protoplasm. As the cell components absorb more water, they soften and swell. Most seeds will double their original volume. This exerts great pressure on the seed covering, and the radicle and plumule escape from the seed coat. The splitting of the seed coat enables more rapid uptake of water by the cotyledons and embryo, and also gives them full access to oxygen in the soil medium.

Inside the seed, the reserve materials become soluble. By a process called diastase (fermentation), starch is converted into sugar; by cytase, cellulose is converted into sugar; and by lipase, oil into fatty acids and glycerine. Carbon dioxide is produced by oxidation of the carbon compounds of the seed to supply energy. Heat is produced by this oxidation. When sufficient food is available for the embryo, its root pushes into the soil to anchor the new plant and to take up minerals and absorb water from the soil solution. The embryonic shoot will grow, the stem tip curved downward in a hook that pulls the young leaves through the soil, with the apical meristem being protected. Germination officially ends when the shoot emerges from the soil. Through this early stage of growth the seedling is completely dependent upon the food supplies in the storage structures of the seed (cotyledons and endosperm).

SOWING SEED

Sow the seeds in pots with seed raising mix. Or, to duplicate nature, sow the seed outside in autumn and wait until spring for germination when the soil temperatures are warmer. Seeds are moistened by the autumn rains, chilled through the winter and germinate in the milder sunny days of spring. The rule of thumb is to cover the seeds by twice the thickness of the seed. But there are always exceptions to this rule.

Examples of special treatments:

- *Alectryon* – soak for eight hours.
- *Carmichaelia* – scarify or soak (hot water treatment) for 24 hours.
- *Clematis* – stratify for four weeks (stratificatication is a period of cold to break dormancy).
- *Fuchsia* and *Gaultheria* – do not cover the seed.
- *Hibiscus* – scarify and soak for 24 hours prior to sowing.
- *Knightia* – gently scarify.
- *Olearia* – sow fresh (like all Asteraceae), on top of the mix or use the scree method (Fig. 4).

Figure 4. The scree method, with stones on top of potting media. Useful for short-lived Asteraceae seeds. The seeds get washed into the gravel and the stones maintain moisture levels.

Once the seedlings are established (Fig. 5), they can be pricked out (Fig. 6). Fill a small pottle up with mix. Carefully lift the seedling from the seed tray or pot without too much root disturbance, and place in a hole in the pottle's mix, gently firming into place. Label the tray and then water in to settle.

CUTTING PROPAGATION

Small softwood, semi-hardwood, or hardwood cuttings are taken depending on the time of year. Bottom heat and a misting system (if available) can be used or place into pots under a polythene bag on a shady bench, or place straight into a trench lined with sand or sawdust in the ground outdoors (Fig. 7).

Figure 5. Different sized seed trays, some with seedlings ready to be pricked out.

Figure 6. Pricking out sequence: making a space for roots, handling seedling carefully by leaf and gently pressing potting media around roots.

Figure 7. Cuttings from locally sourced *Melicytus* aff. *obovatus* from Point Howard.

Cutting material should always be pest and disease free. Semi-hardwood cuttings are usually taken between January and April. Softwood cuttings are flexible but snap when bent. In late spring and early summer (18–24°C is best for root formation), take lateral growths for best results. If using a

misting system, the best season for most species appears to be autumn to late spring (under-bed heating at c. 20°C). Heel cuttings are peeled side shoots from stems, leaving some bark at the base of the cutting which creates a greater cut surface on which roots may form and these work well for the brooms (*Carmichaelia*) and coniferous plants (e.g., *Libocedrus*).

Cuttings should be prepared as soon as possible (Fig. 8). Natural hormones called auxins which are present in the plant tissue move to the cut area to assist in root formation. Wrap a cutting in damp newspaper or moisten inside a polythene bag. Usually take cuttings in the morning when the plants are turgid. If storing due to field trips or overnight stays, place in the fridge or chilly bin. Aerate morning and evening, and give some indirect sunlight, but maintain moisture levels.

Figure 8. Preparing cuttings of *Podocarpus nivalis*, and storing in plastic bag for setting out at a later time.

Most stems benefit from wounding. Take a sliver of the outer bark off to reveal the cambium layer where the roots will be initiated. Make a 2–3 cm slice through both sides for hard to root species or make a cut up the middle of the base. An old method is to place a grain of wheat in the split to keep it open and when the wheat germinates it produces auxin which is required for root germination

The old style rooting media for cuttings is a 50:50 mix of sand and peat. Sharp sand in a trench in the garden bed is good for deciduous plants. Perlite, vermiculite, pumice and scoria in combination with peat and other materials such as river sand, clean topsoil, and even seed raising mix can be adjusted according to the cutting's size, wood hardness, species readiness to root and other factors.

LAYERING AND STOOLING

Layering involves inducing a branch to form roots. Pegs can be used to secure a branch to the ground, or sphagnum moss may be wrapped around

a branch with polythene in what is known as air layering. In both cases, the stem is wounded and hormone powder can be used to assist in root formation.

Stooling is used with species that root easily from the stem (e.g., *Veronica* = *Hebe*). It involves mounding soil up near the lower branches so that they form roots, creating lots of plantlets. Cut back the parent plant, leaving some leafy foliage, and leave over winter so new basal shoots form in spring. Once the shoots are about 15 cm long, cover them with soil but leave the tips exposed. Keep mounding up around the branchlets until shoots are covered to about 25 cm. In early winter, remove the soil and cut the newly formed plantlets to pot up or transplant.

DIVISION

Division is usually performed during winter or any other dormant period of growth and is an easy process. Use two garden forks to split clumps in two. With *Phormium*, flax, the easiest method is to use an axe to split into sections; most fan leaves are then cut back to about 300–400 mm, leaving the middle 2–3 leaves entire. *Phormium* can live bare-rooted in the shade with roots covered for about 9–12 months due to its fleshy roots (all lily-like plants are similar). *Austroderia* (= *Cortaderia*), *Carex*, *Dianella*, and *Festuca* are best divided in late winter or early spring. Most clumps are best with a large amount of root, and the foliage can be cut back by a third (looks ugly, but will quickly regenerate). *Polystichum* and *Pteris* ferns can be divided in winter into small clumps and offsets, respectively. *Rumex* and other plants that die down for winter are best divided when dormant.

The king fern (*Ptisana salicina* = *Marattia salicina*) can be propagated by cutting the auricles (fleshy horseshoe appendages) off a parent plant, and putting into a pot filled with free draining mix. Place in a sheltered shady area.

Davallia ferns, with their creeping rhizomes, can be divided easily by taking 10 cm pieces (cleanly cut) of rhizome and inserting them into damp sphagnum moss. When new tips appear, transplant to potting mix.

FERN PROPAGATION BY SPORE

Prepare a small hygiene tray, with sterilised *Sphagnum* moss in the bottom half and alpine mix (low nutrient bark mix with grit and a tiny amount of lime) on the top half. Spores (collected in a paper bag) are sprinkled on top of the mix, with the tray then labelled and covered with plastic or glass. Put in a large container with about 5 cm of water in the bottom. Put on a shady bench and top up the water occasionally. The best temperatures for germination are 20–25°C. After about 3 weeks, there should be a

green film covering the mix. This is the fern prothalli. After about 6 weeks, the film starts to look a little like moss. After 5–6 months, tiny heart shaped gametophytes develop. The appearance of the first fronds indicates fertilisation was successful. When the first 2–3 young fronds have developed, move the plastic or glass covering to create a small gap. After a few more days, increase the gap. After 2–3 weeks, take it off altogether.

FAILURES – TIMING AND METHODS

The following is a list of hard to work with and unusual plants that are difficult to propagate:

- *Astelia* 'Silver Spear' is a hybrid produced by tissue culture and the seed is infertile.
- *Brachyglottis turneri* never germinates for me, yet seedlings recruit in the wild. I take root cuttings, divisions or stem/leaf cuttings.
- *Carmichaelia* seeds possibly need cross-pollination. No luck with single plant. Heel cuttings work best for this group.
- *Celmisia* seed must be sown fresh (as with most Asteraceae seed) or stored dry in fridge.
- *Discaria toumatou* – have had little luck with this species. The seed germinated but the seedlings were infected with *Phytophthora* (probably got too wet).
- *Kunzea* likes cool rooting conditions.
- *Pimelea buxifolia* – hard to strike roots on cuttings; seems to callous but not root.
- *Pomaderris* – difficult to know when the seed is ready.

SUMMARY

Nature knows best. As a propagator, following nature's clues will help with your own efforts. For example, I've noticed Asteraceae seedlings growing in the gravel around the parent plant; i.e., a natural take on the scree method. Pot-hoppers in the nursery (in areas where weed inhibitors are not used) are easily transplanted. (Some most unlikely plants can germinate, such as the orchid *Spiranthes novae-zelandiae*, which usually requires a symbiotic relationship with fungi.) Rockery seedling plants can be found thriving in a better place than where the parent was originally planted. If you have landowner permission, dig up seedlings from the bush for hard to grow plants (for instance, if they have a long germination period or require difficult germination techniques). After-care is important in this instance as the roots have usually suffered damage. If you learn from nature and study the natural propagation of plants, success can be attained.

ACKNOWLEDGEMENTS

I am especially grateful to Robyn Smith, Tony Silbery, Arnold Dench, and Olaf John. I also acknowledge the books Growing Gardens for Free: A Plant Propagation Guide for New Zealand by Geoff Bryant, and Propagation of New Zealand Native Plants and Cultivation of New Zealand Native Grasses by Lawrie Metcalf.