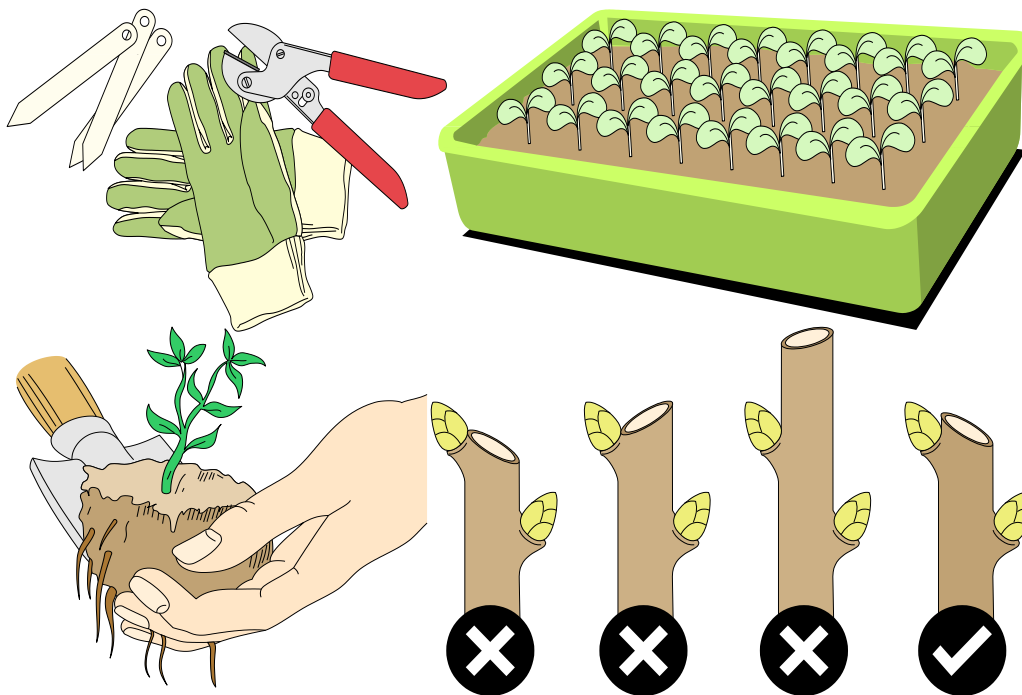


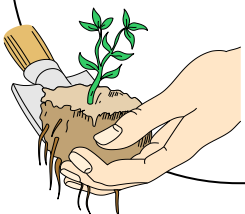


Nursery Operations and Practice



NURSERY OPERATIONS AND PRACTICE

- Preparing materials, tools and equipment for nursery work
- Nursery Practice & Procedure
- Propagation Activities
 - Seed Treatments
 - Seed Raising
 - Cuttings and Layering
 - Record Keeping and Labelling
 - Preparing to pot up seedlings
 - Care and removal of Seedlings/Cuttings
 - Potting-on or Transplanting
 - Care of Seedlings
 - Integrated Pest Management
 - Quality Control
 - Composting materials
 - Dispatching Orders
 - Storing and Stockpiling materials
 - Nursery Hygiene



Preparing materials, tools and equipment for nursery work

Occupational Health and Safety and Safe work practice

Guidelines

The guidelines include safety equipment, personal protective equipment, safe work methods and operating procedures and the safe use of tools in a safe environment.



Risk assessment

A risk assessment must always be carried out prior to starting work or where conditions have changed or a new tool or piece of machinery has been introduced.

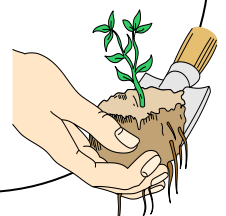


- **Personal protective equipment (PPE)**

Personal protective equipment (PPE) is required where there is a risk of injury or contamination to you or others.

Equipment for use with chemicals or nursery materials may include:

- Respirator for dust or gas particles
- Waterproof boots
- Waterproof gloves made from vinyl, rubber, or synthetic material
- Waterproof pants and jacket
- Waterproof wide-brimmed hat with non-absorbent headband
- Clean overalls or outer clothing
- Face shield or goggles with side shields



Appropriate clothing is required for all nursery work and this includes:

- Strong, sturdy, comfortable, closed in shoes or boots
- Long pants and long sleeved shirt
- Wide brimmed sun hat



Other necessary items of protection include:

- Sunscreen lotion
- Leather gloves
- Sunglasses
- Vinyl Gloves – latex gloves are not recommended as many people have or develop allergies, in the form of skin rashes, to them.



Material Safety Data Sheets (MSDS)

The information on a MSDS outlines the composition of the material, its safe storage, use and application. The MSDS should always accompany chemicals and substances including soil or potting mixes. Users should be made aware of the MSDS and adhere to any recommended safety directions.

Working with soil

In recent years there have been reported cases of Legionnaire's disease or related respiratory type illnesses from exposure to potting mix, mainly from the use of bagged potting mixes. Nevertheless, as a precaution it is imperative to keep soil mixes moist at all times including when moving it from one place to another, this reduces the amount of air borne dust particles. Also, workers are required to use disposable vinyl gloves when handling potting mixes.



Potting and sowing materials

Some other materials used in propagation mixes also have fine particles.

When using these materials a respirator must be worn, and the substances need to be moistened when blending to reduce air borne particle movement.

Problem potting/sowing materials are:

- Perlite (fine silky dust)
- Cocoa peat (dust)
- Soil



Chemicals

It is always best to avoid the use of chemicals as much as possible and rely on alternative methods to control pest and diseases, such as integrated pest management. However, sometimes it is necessary to use horticultural oils, pesticides, fungicides, fertilizers and additives. If using chemicals

- Always read the label before mixing and follow safety directions.
- Gloves and appropriate clothing must always be worn when mixing and applying and
- respirators will be necessary when spraying chemicals.

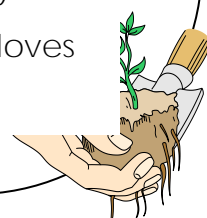
There is a legal requirement under OH&S Act (2000) and the Pesticides Act (2001) for ChemCert training and accreditation for chemical users.

Some chemicals used at TIN:

- Clonex –Rooting hormone
- White oil
- Iron chelates
- Osmocote fertilizer



These are not dangerous substances however always follow directions when applying them and be aware that even though substances may be organic or plant based there may still be a need to wear protective gloves and even a respirator.



Tools and Equipment

For the safe use of the tools and equipment the following is required;

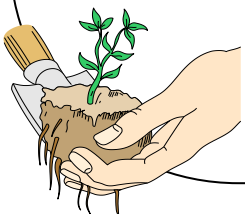
- Conduct checks on all tools and equipment before using them to identify unsatisfactory or faulty items.
- Always use sharp tools with caution and concentration to avoid cuts to hands and fingers. Secateurs, scissors and knives may be used for the propagation and maintenance of plants.
- Use correct lifting methods when you are lifting plants, tools and equipment. Team lift anything that is too heavy for one person.
- Do not overload wheelbarrows and trolleys with soil or plants.
- Wear protective gloves when sorting and neatly stacking pots, pot trays and propagation trays as they tend to attract spiders and other insects.
- Always return tools and equipment to the designated safe storage areas after use. Keep walkways or working areas uncluttered by equipment when temporarily not in use.
- Be aware of vehicle and trailer movement at all times in and around the nursery areas.



WATCH



4



Nursery Practice and Procedure

Propagation activities

Seed treatments

Some seed treatments such as smoked water and boiling water will need to be applied at the time of sowing. Treatments must be applied before the cover of perlite goes on.



Smoked water

Put 10% smoked water into a watering can add 90% water

- In summer cold water is fine to use but in winter it is useful to mix 60% hot water with 30% cold for more activation.
- There are cold climate and germinating species which will not like the heat eg, *Dicksonia antarctica*
- Some species will need soaking in hot smoked water until it cools eg *Grevillea spp.*

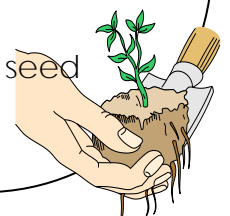
Boiling water

Pour boiling water over the seed in a container or onto the sown seed in a seed tray before covering. It is preferable to do the later as the seed sticks together when wet and is hard to separate.



Procedure

1. Sow the seed onto the surface of the seed raising medium
2. Cover the tray and seed with a piece of cloth and pour the boiling water evenly over the surface
3. Wait until the cloth has cooled
4. Lift the cloth, gently shaking or wiping any stuck seed back into the tray
5. Cover with correct level of perlite as per the size of the seed
6. Follow seed raising procedure to finish the task



All other seed treatments are applied before the seed is sown into the tray eg.

- Soaking and fermenting
- Soaking and drying process over days or weeks
- Hammering
- Burning

The “Seedy Side of Plants” workshop covers all the basic information on seed and is available at TIN to purchase. Part four makes reference to seed treatment guidelines.



Seed Cleaning and Treatment



The Seedy Side of Plants



Lower Hunter Region Community Seedbank



Seed Storage



The Seedy Side of Plants



Seed Collection



Seed Identification



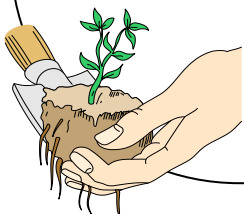
The Seedy Side of Plants



Lower Hunter Region Community Seedbank



Lower Hunter Region Community Seedbank



PRE-GERMINATION TREATMENTS

Treatments aim to mimic the dispersal methods of the seed and often this also includes how the seed is released from its hiding place. Because of the different types of forest and aspects the plant species exists in, some seed have developed certain dormancy techniques to make sure germination will occur in the most optimum place and times for survival.

Fermenting and leaching are used to rid the seed of substances which inhibit germination. Some seed does not need pre-germination treatment and when it reaches the ground will germinate readily. Other seed will take a long time to germinate or not at all unless there has been a fire. Fruit seems to be designed to go through the stomach of an animal to help break the hard testa. It is known that native fauna feed on all kinds of seed and fruit, and that rainforest trees in particular are the product of fauna dispersal. The birds, bats or other animals eat the seed or fruit whole and in flight or sitting on another tree, excrete it. If it is deposited in the best position for maximum germination, the plant will start to grow.

OH&S Recommendations

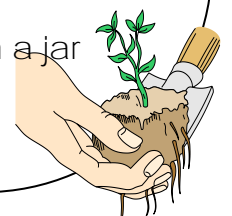
Methods using sulphuric acid should be done with care in a well ventilated area, rubber gloves and safety glasses must be worn, and rinsing water must be on hand. Methods using fire should be in an outside area, long leather gloves and safety glasses must be worn.

Pre-germination Methods Include:

Stratification - placing the seed in a bag or prepared seed tray in the fridge for several weeks or overnight.

Scarification - cutting, scraping, nicking or pouring boiling water over the seed coat for water penetration.

Soaking - softening the testa, and allowing water in. Seed is placed in a jar overnight or for a couple of days.



Fermenting and Leaching - Place seeds in a sealed plastic bag or jar in the sun for several days or weeks. Wash and leach in a nylon stocking in a cistern for 3 weeks. Each treatment may be done without the other for certain seeds.

Freezing - used mainly for plants at high altitudes or affected by snowfall.

Smoked water - Used at 1/10 dilution to mimic rain after a fire.

Pre-germination treatments of seed types

The following information is general to the types of seed and fruit and any exceptions to the treatments will be covered in the spreadsheet provided.

WOODY CAPSULES

Seed must be out of capsule for germination. Can hasten germination with 1/5 diluted smoked water, but is not necessary. Eucalypts from snow or ice habitats should be stratified for success.

PAPERY CAPSULES

Seed must be out of capsule for germination. Treatments vary with different Genus, however usually no treatment is required.

SOFT WOODY CAPSULES

Seed must be out of capsule for germination. Some may need smoke water treatment and others will readily germinate with a short soak in water.

LEGUMES OR PODS

Scarification required and care needs to be taken not to cut the area where the seed will germinate.



Melaleuca nodosa



Lomandra longifolia



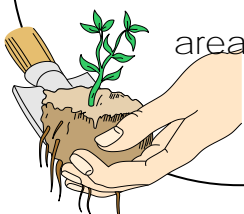
Glochidion ferdinandi



Acacia terminalis



Elaeocarpus reticulatus



DRUPES AND FLESHY FRUIT

Many different ways of allowing water into the testa have been tried, e.g. fermentation, soaking in water overnight, chemical soaking. All methods help to allow water into the testa for germination. Smoked water treatment and breaking the testa with a hammer have also been used successfully; however this depends on the species as the seed can be damaged this way. For the various fleshy seed examples refer to the spreadsheet.



Ficus coronata



Banksia integrifolia



Gahnia melanocarpa



Themeda australis



Brachycome multifida



Isopogon anemonifolius

BERRIES

Generally just washing and cleaning is enough for germination but they can be soaked in water for 24 hours to speed up the process.

FOLLICLES

Can be soaked for a couple of hours to speed up the process (depending on species) but generally not required as germination occurs readily. The seeds may germinate faster when soaked or watered with smoked water.

NUTS

Can be soaked for a couple of hours in water but will germinate readily with no treatment at all. Schizocarps like *Westringia fruticosa* may respond to smoked water.

GRAINS

Some grains need stratification by placing them in a bag or prepared seed tray and placing in the fridge for a couple of weeks, then bringing them out to temperatures up to 24°C to activate germination.

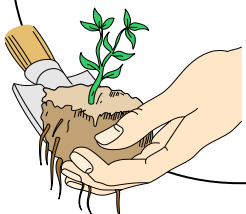
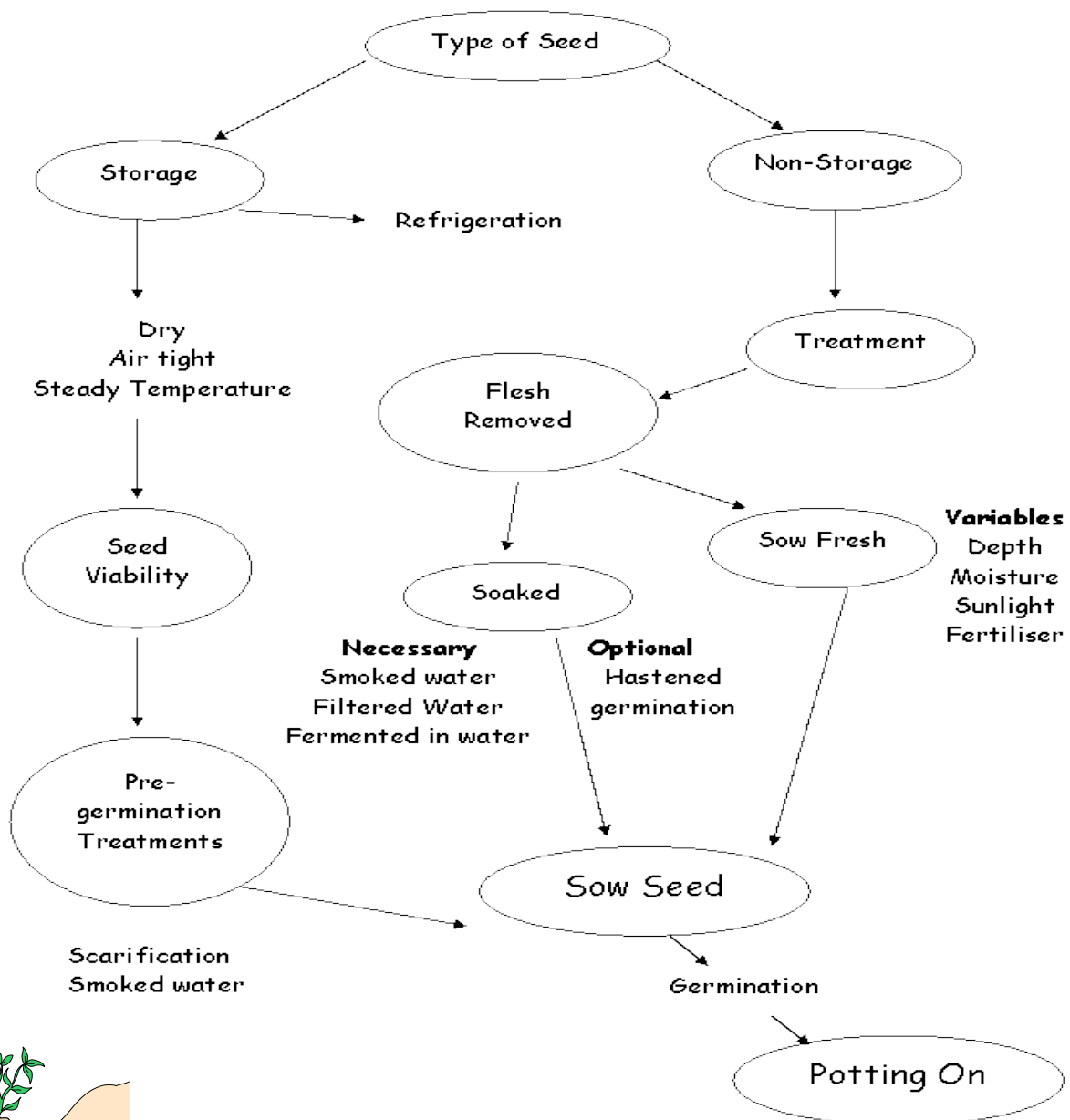
ACHENES AND CYPSELAS

No treatment just add water for germination with the exception of *Pimelea* which needs prompting with smoked water.

CONES

Isopogon and *Petrophile* don't seem to need any treatment but may respond faster to smoked water. Fermentation and leaching or soaking can be undertaken for 3 weeks for *Macrozamia*, or cycads.

Treatments and methods of sowing and propagating native plants



Seed Raising

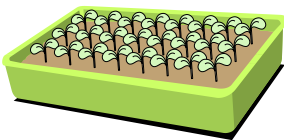
Seed raising or propagating from seed can be an environmentally rewarding activity. If local native seed is used it plays a part in preserving the genetic integrity of our indigenous plants, provides the best habitat and food for our native animals and helps support the biodiversity of what is left of our native plant patches.

Practice

- Tray drainage: Seed sowing trays are usually uniform in size and depth, but vary in the amount of drainage in the bottom. As a rule, anything that likes a wetter root zone will do best in a tray that has less drainage holes e.g. sedges and rushes, *Melaleuca spp.* or boggy plants.



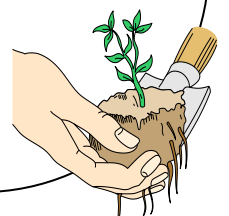
- Amount of seed raising medium: The tray should be filled with the correct amount of medium as per the size of the seed. For example if the seed is fine, the tray should be filled to approximately 2cm from the top. If the seed is larger the tray will not be filled to the top but space left to allow room to cover the seed to its correct depth and bring the medium up to within 2cm from the top.



- Seed sowing depth: Seed should be sown to a depth of the size of the seed width. For example a seed 1cm wide should be sown with 1cm covering of medium. One exception to this is *Crinum pedunculatum*, which has very large seed and does better laid on the surface. Very fine seed should not be covered at all as it falls between the grains of perlite when watered.



- Amount of seed: The amount of seed used per tray will vary in size and sometimes species. Very fine seed will need to be measured out at approximately 2 teaspoons per tray.



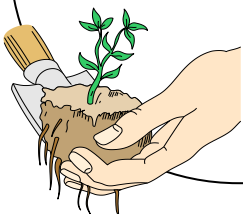
- Distributing the seed: It is easier to mix the seed with sand to spread it more evenly, but if you are experienced, taking a pinch of seed in your fingers and dispersing evenly over the medium works well too.

Waiting for germination



Research the requirements of your seed before sowing to ensure you can meet the needs of the seed for successful germination and not waste the seed. There are plenty of books to help you and TIN has a Seed Data Sheet you can purchase for a small amount. Storing seed trays in the correct place for germination is an important part of the process. Things to consider include

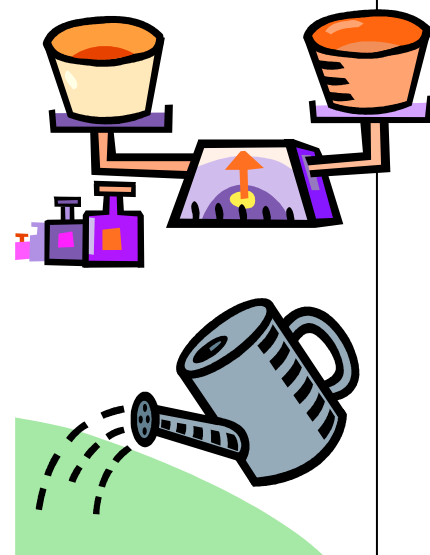
- Some seed likes to be continuously wet to germinate and others like to dry out before getting wet again.
- Some seed will not germinate unless the ground temperature reaches 24 degrees and others need to be chilled.
- An igloo will be invaluable in harsh weather, a heat bed invaluable in cold.
- When days are mild many seed types will germinate in an outside, protected area as long as you can control the water required.
- A bog garden or water tray to place the seed trays containing some species like *Gahnia aspera* may be necessary for successful germination.



Procedure

Refer to the information above and

1. Choose a tray that suits the species you intend to sow
2. Fill the seed raising medium as per your seed type (previously mixed see below).
3. Measure out the seed to sow
4. Choose a sowing method
5. Disperse the seed evenly on to the surface
6. Treat the seed as per requirement
7. Water again after the seed is covered and/or treated (with water or previously treated water).
8. Place tray into an igloo, on a heat bed or into a protected growing area
9. Mist water twice a day or as per species requirement



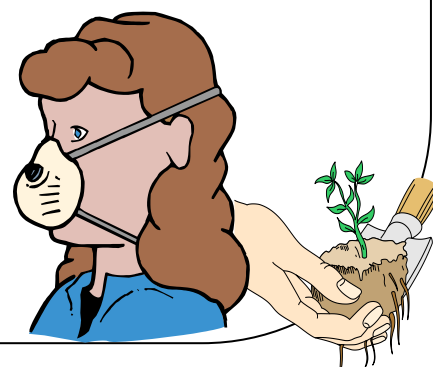
Preparing seed raising medium

Follow all safety directions when mixing component materials. Always refer to the Material Safety Data Sheets.

All seed raising recipes have been developed by trial and error experimentation over the years at the Trees In Newcastle Nursery. At times we have varied the mix depending on the seed we are sowing. For example we sometimes use a mix of $\frac{1}{2}$ bag of coarse perlite with $\frac{1}{2}$ bag of fine perlite for very fine seeds, this is so the ratio of soil does not need to be increased.

To prepare seed raising and cuttings medium you will need the following;

- A dust mask and gloves
- The materials
- A bin for mixing the different parts – a hand rotating compost bin is great



- A bin for storing the mixed parts preferably with a lid or under cover
- Seed raising trays- shallow trays with drainage holes in the bottom.

Cocoa Peat

Half fill a large rubbish bin with cocoa peat and pour 4 litres of boiling water over it. When the material has cooled pour enough cold water over to allow the cocoa peat to swell but not be soggy. Mix thoroughly before adding to the mix.

This process allows material to be more evenly mixed in the medium and alleviates the problem of robbing the other materials of moisture while mixing and in the seed tray.

The following table shows the materials and the particular part they play in the mix.

Amount used	Material	Use/ Role	Comments
1 bag 100L	Coarse Perlite	Structure and Aeration	Allows oxygen into the mix and is light enough for sprouting seeds to push through and limits bruising of new roots
1 Bucket	Soil	Bulk/substance	Without soil fine seeds will fall to the bottom when the tray is watered
1 Bucket	Worm castings	Nitrogen	Provides nitrogen and some trace elements and doesn't change the pH
1 Bucket	Cocoa Peat	Retains moisture	Too much will retain too much moisture and will grow fungus. See Cocoa Peat information
¼ bucket	Vermiculite	Trace elements and minerals	Use the correct amount as stated in the Practice guidelines.
¾ cup	Slow release low Phosphorus fertilizer - Osmocote	Provides a sustained and continuous supply of fertilizer over time	As the plants germinate and grow they use the available nitrogen in the seed raising medium. The Osmocote continues to release plant nutrients to the soil ensuring their continued availability.
½ Bucket or more - check moisture	Water	Moisture	Water should be applied after the perlite is put into the drum to minimise dust.

• Cuttings and layering

Some plants are difficult to propagate by seed. This is often because their seed has particular requirements for germination that are not easily reproduced in the nursery. Another reason could be the sporadic producing and shedding of the seed that makes it hard to collect.

Often it is easier to reproduce particular plants from cuttings or layering because the plant's physical structure lends itself to this kind of propagation. Vegetative reproduction methods produce genetically identical plants to that of the parent plant, whereas seed produces a genetic combination from that of the parent plants.

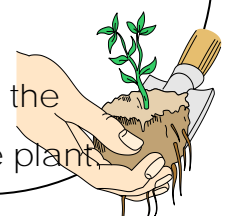
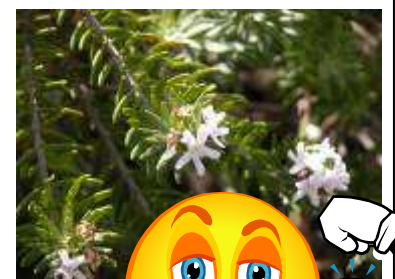
Collecting plant material

The best time to collect plant material for cuttings is in the morning when the day is cooler. It is also important to avoid collection and cutting materials when it is extremely hot or very windy as the loss of moisture and stress on the plant material will be increased and it is likely that cuttings will fail.



Always collect plant material

- from strong plants: Strong plants produce strong cuttings and strong new plants.
- from healthy plants free from pests and disease: Pests and disease can be carried on to the next plant if your parent plant is the host.
- from the form and flower particulars you wish to duplicate: Never take too much material from a plant at one time and be aware of the new form you are leaving behind on your parent plant.
- from above the node or growing part of the stem from the parent to minimise moisture loss and dead parts on the plant.

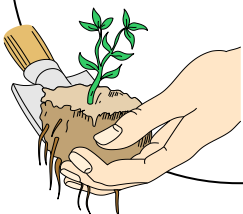
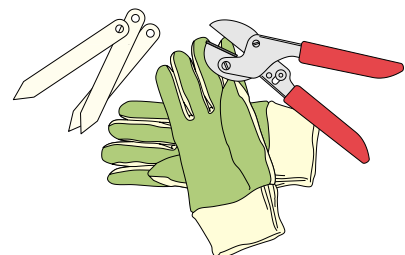


Best practice is to do the cuttings or layerings straight away. However if you are in the field, put material in a moist paper bag and place this in a plastic bag, keep in a shady and cool spot until you return.

If it is not possible to do cuttings until the next day, keep them in the 'field' bag or sprinkle a bit of water on them, place them in a plastic bag and put them in the fridge. Never keep them in a bag of water in the fridge as they will rot. They should be discarded after a couple of days.

Taking cuttings

- Layerings and cuttings can be taken all year round provided they can be kept warm and still when they are producing their roots.
- At TIN we predominantly use stem cuttings made from last season's hardened wood. This occurs between the sappy new growing tip and the last year's hard wood. It is the best part to take cuttings from as it is not too old and therefore harder to strike and not too soft and young, which has a tendency to lose moisture too quickly and die.
- Roots form from the nodes or growing leaf parts of the stem because the plant cells that are able to divide and make new cells, cambium stem cells, are in contact with the growing medium.
- Any plant part that is flowering and seeding should be removed as the energy needed for making roots will be directed to continuing the reproduction process.
- It is important to use sharp secateurs which will not tear the stems. Rose cutting snips are ideal.



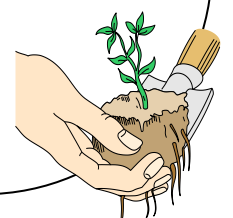
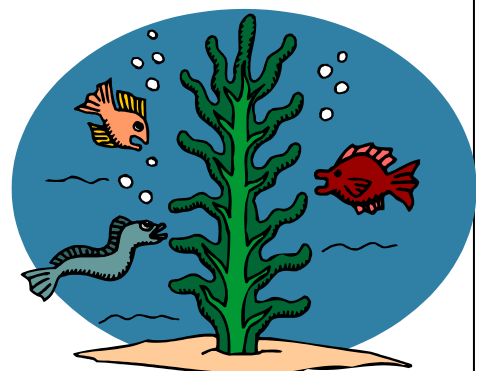
Rooting hormone

Rooting hormone does not make roots on stems which would otherwise not be able to make them, e.g. very hard wood or branches or stems without a node. Its role is to support roots to grow a strong connection to the cambium, the cells that are able to divide and make more plant cells.

There are lots of hormone products to choose from in the market place, from powders to gels. Our nursery uses a product called Clonex but you can make your own.

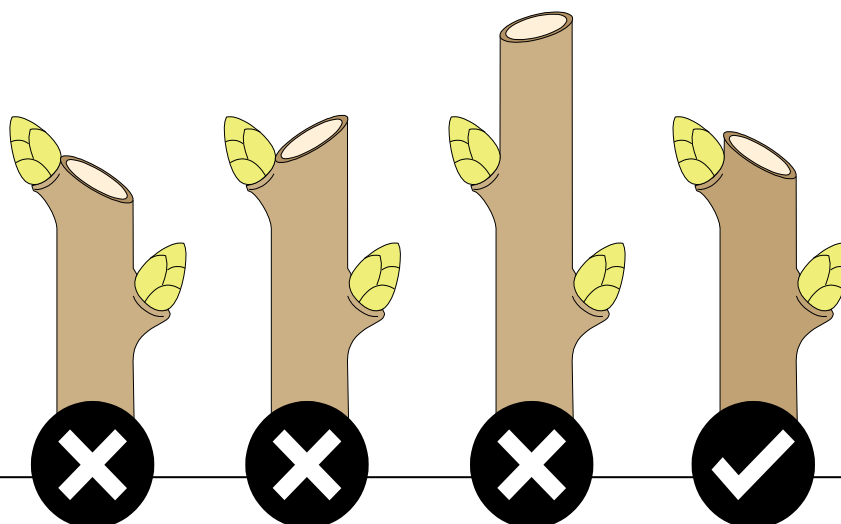
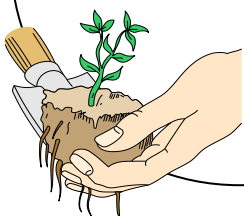
Home Made Hormone dips

- It is possible to use honey that has not been heated and still has all its properties.
- A gel can be made by soaking willow wood in water on the window sill for a week or until the water starts to thicken. When the medium is mixed and laid into the trays it must be watered down before the cuttings go in.
- Seaweed solution supports root growth also.



Follow the procedure to take cuttings:

1. Fill a tray with your medium to the top and water well
2. Start from the top of the plant material
3. Find where the soft and sappy part finishes by bending it gently with your fingers
5. Cut just above the node, where the leaves are growing from and where the material starts to harden
6. Trace down three more nodes (or for those plants with lots of space between them a distance of 4cm) to the strongest node for growing roots
7. Cut just below the strongest node
8. Take your thumb and forefinger and gently scratch away the raised part of the node exposing the cambium
9. Dip the stem into hormone gel
10. Dibble a hole in your seed raising mix with a stick or handle of a metal fork (dibbler)
11. Place cuttings in the tray so as to allow airflow around each but also maximise space
12. Space cuttings to allow air flow and maximize use of space
13. When all the cuttings are placed into the tray it must be watered
14. Label the tray
15. Place tray in a warm still space (preferably on a heat bed)
16. Water every day until roots form and its time to pot them up



Layering

Layering is a method we use for plants that have a ground cover form or growing habit and new parts are produced vegetatively . This method can also be used for herbaceous plants .

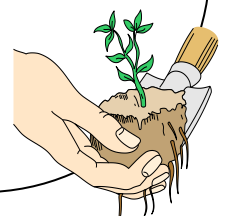
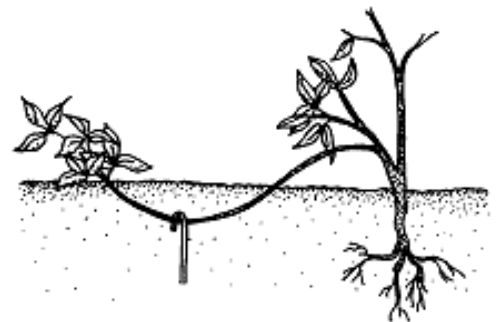
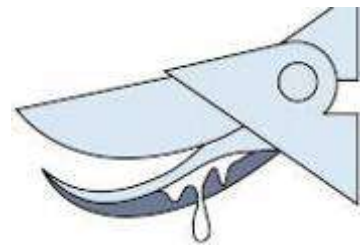
Rooting hormone is not necessary for this method as plants have adapted well to propagation by vegetative means.

Your aim is to make roots from each node that makes contact with the soil. After the individually rooted sections are ready in the tray they can be cut into individual plants.

Further by using this way of propagation in a tray you are making an instant square of ground cover to plant out with little fuss.

Procedure for layering:

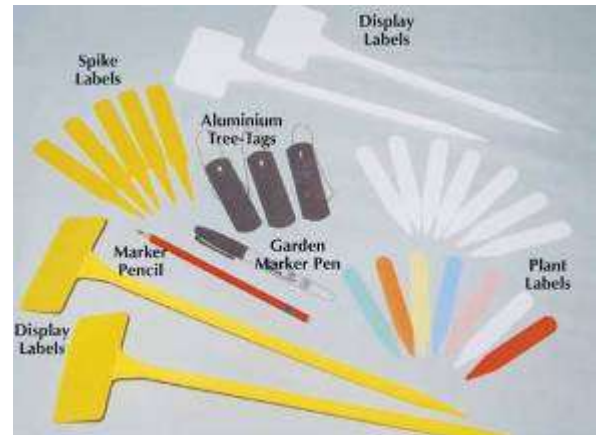
1. Fill a tray $\frac{3}{4}$ with your medium and water well
2. Choose clean, sharp secateurs
3. Start from the new grow tip
4. Cut off any very young parts or alternatively leave on with a stronger node along the stem for support
5. Identify 2 to 5 nodes or a length compatible with the size or length of your tray.
6. Lay the running stems in a line next to each other on top of the medium
7. cover the stem parts leaving any leaves exposed above
8. Water well
9. Label the tray
10. It is not necessary to place these on a heat bed but somewhere warm and sheltered will be ideal



• Record keeping and labelling of plants

Records should be transferred to the label in the pot or tray and should always be done before the seedlings are potted to avoid forgetting or mixing them with other plants.

It is most important to keep records of plant species and the area from which plants came from.



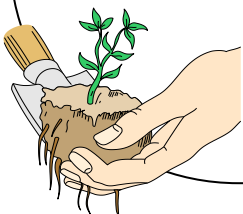
Labelling of seed trays and trays used for cuttings and layerings is important

- to help you distinguish between the species when they germinate as this is a most difficult time to spot the differences.
- to help differentiate between the collection sites and the parent form, flower colour or fruit size.
- to indicate how long you need to wait before identifying that the seed has failed and should be re sown.

Each seedling tray should have a tag label with the following information on it

- Name of the plant
- Provenance of the plant
- Date the seed was sown or the cuttings were made
- Batch number
- Specific information eg. pink fruit or white fruit

We are developing a Plant Propagation database that identifies all of the information above plus type of fruit, when its ripe, dispersal method, storage viability, germination time and germination methods trialled



- Preparing to Pot up seedlings

Preparing soil

Native plants prefer an acid soil and most will thrive in a free draining soil but some will prefer the soil wet and some will only survive if the soil is drier.

Some coastal species prefer well-drained sand based soils so if your soil is not very sandy you could mix coarse river sand to your commercial soil mix at the ratio of 1:2.

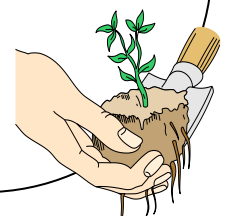
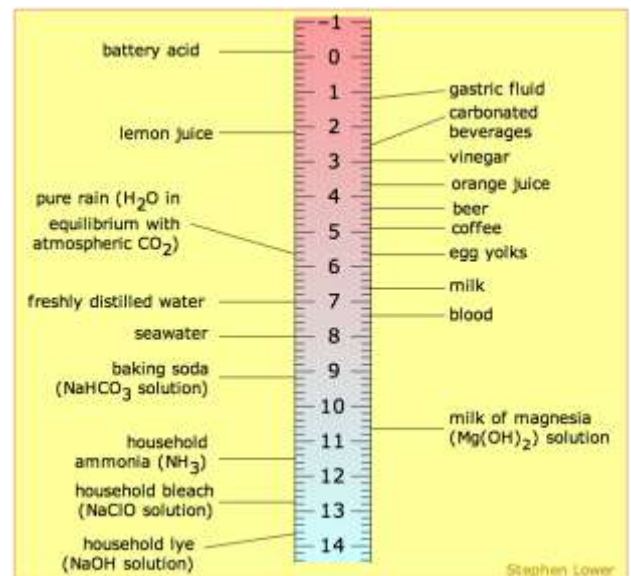
At TIN all seedlings and cuttings are potted up with our commercial potting mix which is a 50%coir and 50% organic mix. Make sure the distributor has not added a fertilizer rich in phosphorus.

The soil is placed in a wheelbarrow and a slow-release, low-phosphorus, native fertilizer is mixed thoroughly through the soil.

Soil mixes should be moistened at all times, particularly when moving or mixing soils to reduce air-borne soil particles.

Use a potting mix which is:

- Organic
- Free from added fertilizers
- Between 6 and 7 on the pH scale
- Freely draining - contains 30% sand
- Moisture retaining and contains an equal part of coir or cocoa peat.
- Is weed free
- Has a low ratio of wood additive



Pot selection

There are various sizes of pots that are used in the nursery. They are used for various reasons

- ease of planting out
- length of growing tap root
- height of plant at its strongest point before planting
- size dictated by ordering specifications

The following is a guide:

- grasses and sedges go into cells, hikos or regular tubes,
- shrubs and trees go into regular tubes, and
- Rainforest species go into large tubes.



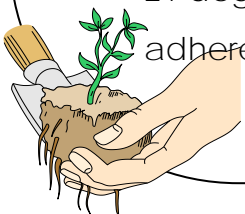
Fertilizers

As a rule of organics you should be feeding the soil so the soil can feed the plants.

Soils should be

- low in pH (between 6 and 7)
- low in phosphorus and
- low in nitrogen.

It is important not to raise the pH by adding the wrong fertilizer. It is also possible to burn plants by using too much fertilizer. A soil temperature of 21 degrees helps to break down the fertilizer. Always read the label and adhere to the rates recommended.



The Trees in Newcastle nursery uses:

- Osmocote slow release (8-9mths) with a break down of:
- 16 % total nitrogen,
- 1.3 % phosphorus,
- 9.1 % potassium.
- Mixed trace elements

Fertilizer rates vary seasonally to $\frac{3}{4}$ a cup in autumn and winter and $\frac{1}{2}$ a cup in spring and summer per wheelbarrow of soil.

Use a fertilizer which is:

- low in phosphorus
- low in total nitrogen
- a slow release over 3-6 or 8-9 months
- low in salt
- alternatively mix 20% worm castings or well rotted compost in to the soil

Soil conditioners/boosters

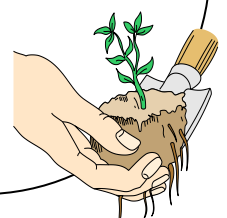
These are not necessarily fertilizers, though they help with plant health.

They are usually trace elements with a small amount of nitrogen. They can be obtained by adding a seaweed mix as sludge into the soil or as a tea provided in the watering when the plant is potted on. Watch out for high nitrogen and phosphorus additives.

Sea weed solution

Commercial Seaweed

It is preferable to purchase a solution which has no additives. Many seaweed solutions on the market are aimed at the vegetable and fruit growers market so they have added phosphorus and nitrogen to make them a fertilizer aimed for quick growth and consequently quick harvest.



Native plants have adapted to a low phosphorus 'lifestyle'. Too much phosphorus makes them take up too much nitrogen which makes them vulnerable to pests and disease.



1. *Home grown seaweed solutions*

Collect seaweed from the lakeside or sea side (always check to see if it's ok in your area and don't take too much. A 20kg limit applies in Lake Macquarie for Seagrass wrack).

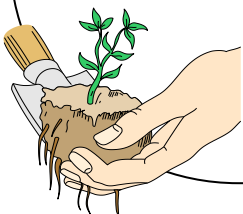
- Wash it down and place it in the sun for a day (or put it in a bin, soak for a day and pour the salty water off)
- Place it in a bin of fresh water
- Stir weekly
- Let stand for 6 weeks
- Strain and dilute 1:10

2. Purchase seaweed meal from a pet produce shop.

- Mix 1 cup of meal to 1 large rubbish bin
- Stir weekly
- Let stand for 6 weeks
- Strain and dilute 1:10
- Use the sludge for damaged plants, to heal wounds and in seed raising trays. Also 1:10 or a table spoon per tray instead of vermiculite

3. Seaweed solution

- Dilute seaweed solution to 1:20
- Dilute 1:30 for Proteacea family, eg. Banksia sp.



• Care and removal of seedlings/cuttings from propagation trays

- Seedlings need at least 2 true sets of leaves after the cotyledons to be big enough to pot up and cuttings need strong root formation.
- Do not remove more plants than would be possible to pot-on given the time or amount of people aiming to do the job.
- It is most important that the potter does not touch the seedlings too much or leave them to dry out: both will cause fatality.



Procedure

• Choosing the plants:

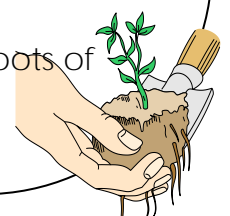
- Plant readiness for potting-on is determined by the TIN Guidelines and the supervisor (see above).
- Plants with two cotyledons and at least two first leaves are chosen depending on the species e.g. *Leptospermum sp.*, *Melaleuca sp.*, *Eucalyptus sp.* and *Callistemon sp.*, monocotyledons (grasses and sedges).
- Alternatively if all plants are large those in one corner of the tray that are the biggest are chosen



- Water the seedling tray with seaweed solution
- Place a fork gently into the seed tray contacting the bottom, slide the fork under a small clump (6 to 10 plants) of the biggest plants and gently lift out by holding a clump of the top-most leaves.



- Put diluted seaweed solution into a shallow dish and place the roots of the seedlings in this till needed. This will have a tri-fold action

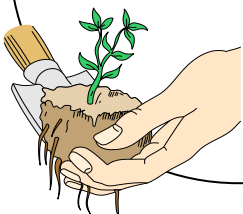


- Seedlings will not go into shock as they are kept moist
- The seaweed adds minerals to lessen the shock
- The water will aid in loosening the roots.



- Halve the seedlings into clumps by gently placing fingers around the leaves. Ease them open and apart a little, taking care not to damage them. Manoeuvring the plant or turning the clump may be necessary to help untangle twisted roots. Stop pulling if any resistance is felt. Repeat this until half are singled out.

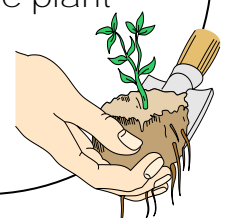
- Seedlings that are individually separated should be laid in a line on the bench all with roots at one end and leaves at the other. Organizing the seedlings this way:
 - helps the potter to pick them up without damaging other plants with too much handling, and
 - there will be less danger of getting them mixed up with the main body of soil.
- Care should be taken to sustain the life of the seedlings or cuttings. If you need to take a break by either:
 - lay damp soil along the roots of those you have removed and apply a small amount of water, or
 - place them gently back into the shallow dish of seaweed solution.
- Plants should not be left in the water overnight as they will get waterlogged and die. Place them back into the seed tray and support them with more seed raising mix instead.
- Any seedlings not potted-on at the end of the task will be replaced right way up back into the seed tray and seed raising mix replaced around the roots. The tray should then be watered before being put back in the igloo or in a protected site.



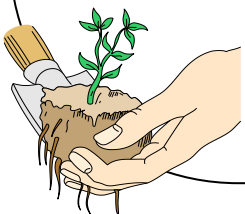
• Potting-on or Transplanting

Safety procedures must be taken into account:

- Choose the container as per nursery standard
- Moisten the soil stockpile
- Shovel soil from soil bay to wheel barrow as guided by manual lifting OH&S standards
- Wheel the barrow to potting table with shovel on top, facing down and handle situated in between wheel barrow handles
- Place $\frac{1}{2}$ to $\frac{3}{4}$ cup of fertilizer into wheel barrow
- Mix through with gloved hands or shovel, making sure soil is blended thoroughly and moistened evenly
- Shovel soil onto potting table making the soil pile easily accessible to the people working around the table
- Check pots are clean and spider-free by pulling apart
- Retrieve the correct trays for holding pots
- Follow seedling removal TIN procedure
- Fill the pot/container with soil, shaking it down, but not compacting it and add more to mound on top
- Make a hole of sufficient depth (check the size and length of the roots) with your finger or a dibbler stick
- Hold the seedling or cutting by the upper leaves (avoid touching the lower stem), and place it in the hole, so as the roots go straight down and do not fold back up
- Holding the plant in the hole with the cotyledon leaves just above the level of the top of the soil, with your little finger leaning on the ridge of the container for stabilization, add soil around the stem and roots till the seedling is supported
- Gently firm down the soil around the roots and give the tube or pot a tap on the table to release any air pockets. The plant will drop down sufficiently in the pot



- Add more soil so that the cotyledons are sitting on the surface of the soil and the soil should be close to the top of the container - but not mounded above
- Place potted seedlings into a tray
- Keep the tray shaded until it is full
- Place the tray onto a trolley
- Fill a watering can with seaweed solution as per nursery standard and water well
- Water the tray evenly, being sure not to miss the corners or the edges
- Write up a label and place this along the edge of the pot or tube, so as not to sever the roots, and deep enough to allow it to stay in the tube for transport. Some genera need more than one tag because if the tag was to fade or break or disappear the species would be unknown and impossible to sell, e.g. *Eucalyptus sp.*
- Place the tray in a sheltered position, a shady area or shade house, away from strong wind and full hot sun for at least a day.



• Care of seedlings and growing plants

Growing plants in pots need special care. They need monitoring daily for:

- Adequate watering regimes
- Deficiencies in nitrogen and other elements
- Weeds
- Pests and disease



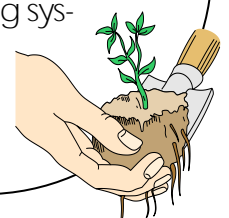
Watering and Irrigation

Water is vital to a plant's survival and monitoring the moisture level of the potted plants is essential.

- Seedlings and cuttings must be watered well after transplanting. They need to remain moist at all times until their roots can support the growth of new leaves and a stronger stem.
- Pots and tubes dry out very quickly and even more so if they have filled out their pot. Also in hot and windy weather tubes may need to be watered at the end of the day as well.
- Pots that have dried out drastically will need a good soak by filling up a sink, wheel barrow or bucket with water and seaweed solution and holding the pot under until all the bubbles have stopped. Even 10 minutes soaking with a hose will not be enough to revive the plant or get moisture into it adequately.
- If plants need delivering to another site or will be picked up at a scheduled time it will be good practise to water them well for their travels.



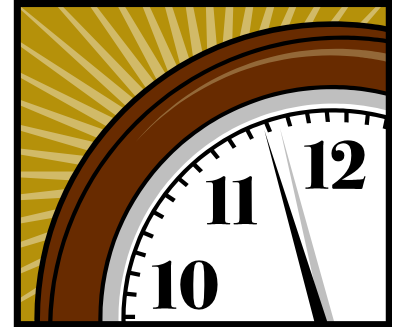
Appropriate irrigation is essential for watering larger areas. Automatic watering systems on timers can save money and time and save your plants from drying out excessively.



Throughout the year the duration times of watering will vary. Winter months will have a shorter watering regime and less frequency than summer months.

Winter regime

- 10 to 15 minutes twice a day,
 - one just before sun rise to reduce possible frost damage and
 - one about 12 noon to give enough time for the plants to dry before night fall to reduce fungal growths



Summer regime

- 20 minutes, 2 or 3 times a day or
- 30 minutes twice a day

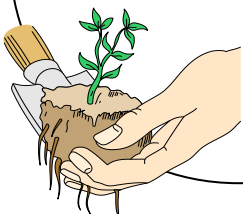
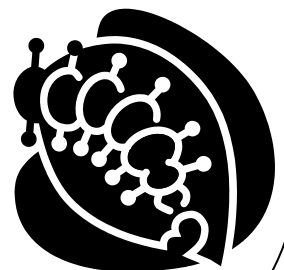
There should be flexibility to change the duration and frequency if there is an extreme weather event or strong, hot or cold winds or for very large plants, for example.

Manual watering can be undertaken by either opening the gate at the solenoid or by selecting manual watering on the timer dial. There is also usually a rain delay button to use in the event of rain.

Please refer to the irrigation section in Part One [Nursery Establishment](#) for further information.

Integrated Pest Management

Mother Nature has a brilliant way of keeping things in balance. By spending the time looking and noticing what happens in your environment you will get clues as to what to do to keep weeds, pests and diseases under control.



Integrated Pest Management is simply a way of monitoring plants to determine if treatment is required for weed, pest or disease problems and alleviating any problems with non chemical solutions first.

For example, at the TIN nursery we have chosen not to use poisons for surface weed control in pots or for pests as we have a large number of people to support manual removal techniques. We also provide habitat around the nursery to encourage natural pest predators such as spiders, millipedes and centipedes, frogs, lizards and birds. Wasps are also important in the system however if they are nesting or foraging in prominent public places in the nursery they must be removed.



Disease can be a product of the surrounding environment and / or deficiencies in the plant's nutrients, minerals and trace elements. Disease can often be remedied by replacing what is needed with a conditioner or fertilizer and simply cutting back the damaged plant part for rejuvenation.

TIN nursery staff sometimes use white oil or soapy water for heavy infestations of scale or aphids.

Pests or disease?

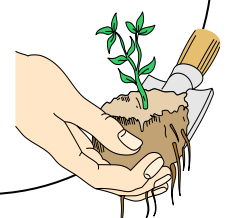
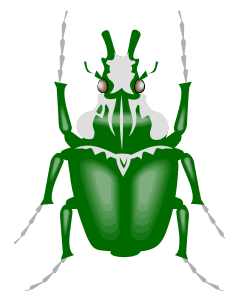
Start by looking for faeces or signs of a host living in or under the pot or under or in the leaves or in the stem.

If you cannot locate any animal, look for signs of fungus on the surface of the soil, on the stem or on the leaves.



Some common pests in young plants are:

- Psyllids
- Aphids
- Lerp
- Gall Wasp
- Leaf Cutters and miners
- Leaf hoppers



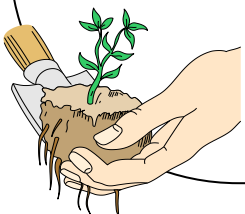
If you can't find signs of either pests or fungus, it will be likely that you need to look up symptoms for a plant disease.

Weeds

There are number of strategies to keep your nursery weed free:



- Removing the places weeds can grow
- Plant out garden edges, under tables, in igloos, shade houses and fern houses with appropriate native plants. Native plants can play several roles in the nursery apart from taking up the excess water from irrigation in each section . They can be very useful :
 - Garden edges can be planted with appropriate sized plants for protection from sun and wind and as a display of plant growth characteristics of those that are sold in the nursery. Remember to include ground covers.
 - Under tables need to be low, shade loving, moisture loving species e.g. *Viola sp.*, *Ranunculus sp.*, which not only minimise weeds but gives predators somewhere to breed and live to support pest control.
 - Shade houses and fern houses can be planted with shade loving ferns and ground covers that double as parents for propagation.
- Keep on top of weeding by scheduling an on-ground weeding activity every morning for 20 minutes with a few people. Daily attention helps catch seeding plants and those that grow vegetatively from spreading around the site
- Daily monitoring and removal of liverwort from your pots and noxious and environmental weeds from adjacent sites is also important.



• Quality Control

Quality Control starts with the potting-on of the seedling. Care needs to be taken to train potters in the correct procedures and monitoring what needs to happen at the table with each new type of plant potted.

As the plant grows it may need trimming to retain a good shape or to control its size or dead parts may need cutting off to deter fungal growth and keep pests from entering the plant.

Monitoring for deficiencies, pests and disease and providing treatment and solutions swiftly will be the difference between healthy strong plants and wide spread nursery problems.

Adding more fertilizer

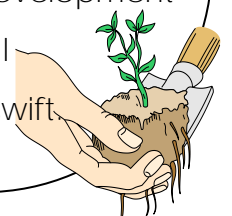
To determine when to add more fertiliser use the date of potting up as your start date and add on 3 or 6 months (depending on your fertilizer release time frame). If the plant is showing signs of low nitrogen then you could do one of three things

- Make a shallow hole into the pot and add 4 or 5 granules of Osmocote
- Apply worm castings directly to the surface and water well
- Apply seaweed water solution to the leaves (foliar spray) or soak in seaweed solution once every week until plant picks up

If your soil is full of wood it will rob your plants of available nitrogen. If this is a problem, you will need to add more nitrogen to the soil when initially potting up in the form of worm castings, seaweed extract or compost.

Correcting a deficiency

Trace elements are necessary for healthy plant growth. When something is missing or unbalanced a plant will show signs in the flowering, fruiting, form development or leaf growth stages. This should be remedied promptly as the plant will quickly decline if not treated and will likely recover if treatment is swift.



Banksias grown in pots frequently show symptoms of iron deficiency for example and so an iron supplement (Iron Chelates) is a useful additive for quick pick up.

Seaweed can be made up as a foliar solution and sprayed on to the leaves.

Potting plants into larger sized pots

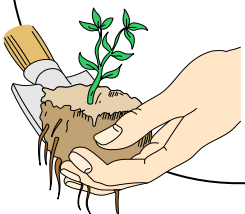
Plants that have filled their pots may need to be potted into larger pots otherwise they will begin to decline in health.

Special or rarer plants could be potted into 8" pots to allow them to grow more fully and enable a more accurate price to be charged. More common plants may not sell in large pots and so may need to be either potted into the next tube size up or sold at ½ price for quick sale and planting, before they start to decline.

Composting Materials

There are two compost types that could be useful to the nursery system.

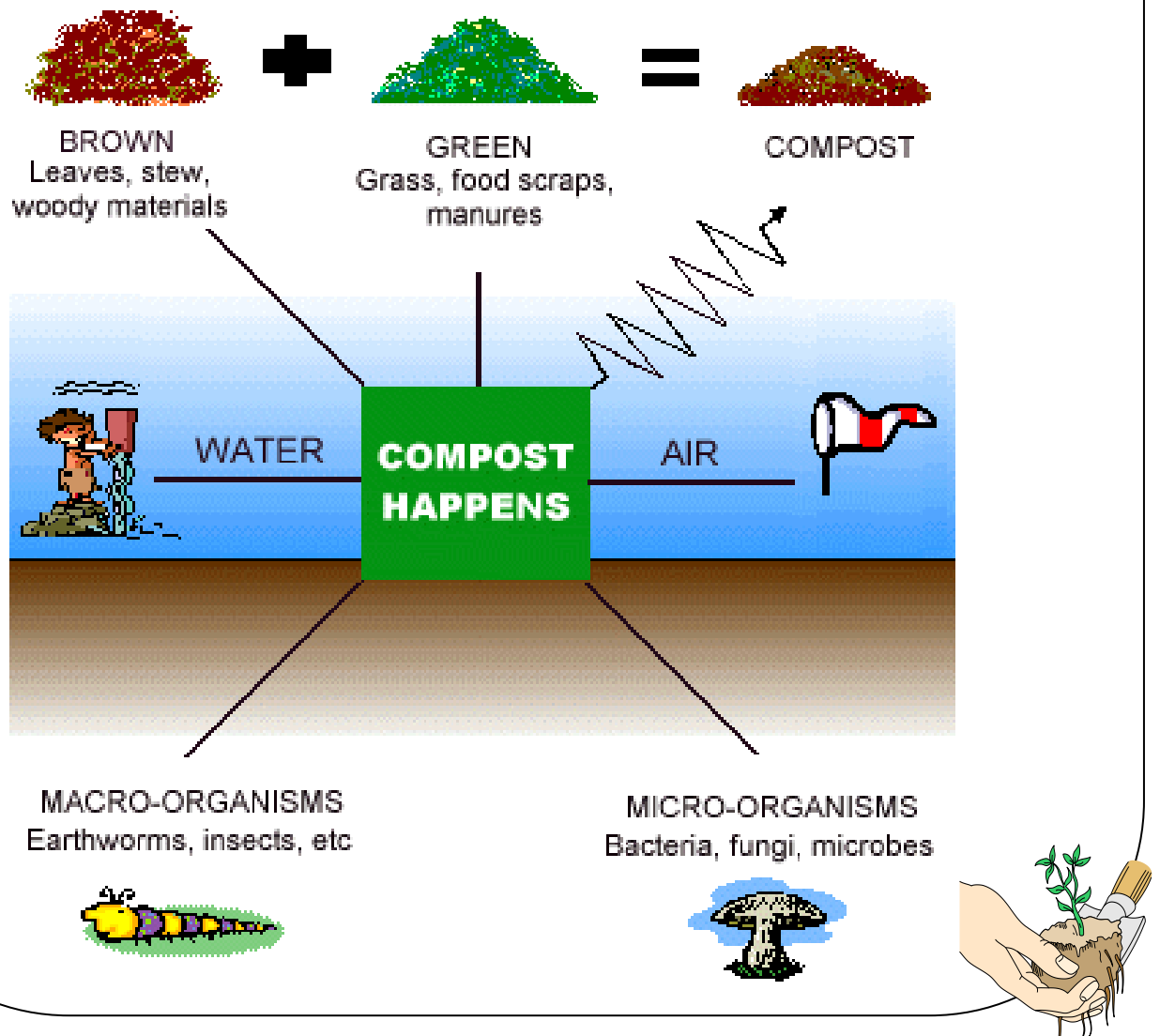
- *Anaerobic*
This is compost that does not require turning but it takes sometimes two years to break down the material if it is continually added to. Any weed seed inside the bin will germinate and quickly turn into composted material if it is covered and continually added to, otherwise it will grow in the bin and need turning in
- *Aerobic*
This is compost that is generally covered, but needs turning to activate the decomposition Also a balance of materials is necessary for a good heap. For example 1/3 nitrogen 2/3 carbon with an activator gets the process happening.



All composts need an activator or a catalyst to decompose material. Some activators are :

- Manure
- Seaweed
- Comfrey
- Nettle
- Yarrow
- Slush from other decomposing materials
- Air and moisture

Well broken down compost should be pH neutral and you should not be able to discern the materials that went in.



T.I.N compost system

1. There are 2 green turning bins to fill with weeds till 2/3 full

- Always add an activator like slush from the water bin and or manure provided in the bin at the back
- After full do not add any more material until again empty
- Bins need to be turned for 6-8 weeks in summer and 10 -12 weeks in winter
- Check for breakdown before emptying in the open bay - you should not be able to discern any form of material put in the bins previously
- Compost is used for gardens until screening is done

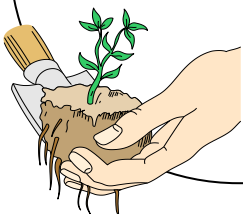
2. There are 3 wheelie compost bins for placing of all weeds, waiting to go into the turning bins..... do not overfill them

3. There is a water bin for placing all weeds which will not break down in the green bin system, they are often bulbs and stolons and tubers, cactus and stubborn grasses.....do not over fill this bin

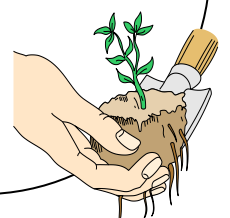
- This bin will always be filled with water and left to ferment.
- Fermented water, mush and decomposed vegetation will be put into the 2 green turning bins as an activator when they are started again.
- If it is over filled, the weeds will grow instead of fermenting.

4. Very bad environmental weeds

- a. It is possible to break these down in the water bin, but there are too many of them so they will be placed in a bag and left to rot down for a couple of months and checked on periodically.
- b. The broken down mush will then be placed in the water bin to be further composted.













- c. It can also be taken to the university nursery site to await further break down in the composts there. It is important that the material be mostly rotted by this stage, to avoid it growing in the composting heap if it doesn't get hot enough.



• Dispatch orders

Design an order form that has a place for the following details:

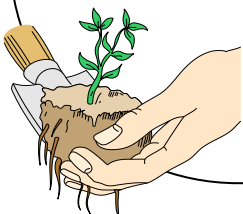
-  Name of customer
-  Contact details
-  Date the plants were ordered
-  Date the order is wanted
-  Mode of dispatch- pick up or deliver
-  Provenance of planting
-  Map Unit Reference eg MU13
-  Species required
-  Numbers required
-  Price of each unit and totals



Procedure for dispatch

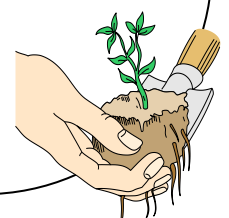


1. Fill the order as per species list
2. Call customer about any substitutes or changed numbers
3. Place a tag in each tray on the outside to identify the order
4. Place tray in close proximity to others in the order, in the designated orders area
5. Record the number of plants given on the appropriate place on the order sheet
6. Add up the unit prices and total
7. Prior to the customer arriving or loading the plants take the trays to the main table for weeding and checking for moisture, quality and dead plants
8. Replace dead or sick plants
9. Check off the plants with the order sheet to complete the delivery or dispatch
10. Load plants for delivery into the most accessible part of the trailer or car and group them in their types for easy counting
11. Get the customer to sign off when they receive the order



Loading and unloading nursery stock

- It is helpful to have more than one or two people to load and unload stock. Repetitive movement over a long period of time is detrimental to health.
- Try and use the trolleys where appropriate to alleviate strain and stress.
- Orders should be kept together in the trailer.
- When moving plants to growing on areas or sale areas, try to move them batch by batch and type by type so as to order the work activity, save space and avoid double handling at a later date.



• Nursery hygiene

Keeping the nursery clean and tidy is important for appearance and organisation but also helps to reduce weeds, infection, fungus and pests.

Procedure and practice

Separating weeding and pruning activities from potting and propagation is very important to minimize the spread of weeds, fungus, disease and pests .

At the end of each work activity:

- Wash down benches
- Clear dead plant parts away quickly
- Wash out kidney trays and seed soaking containers after use
- Wash used utensils including secateurs in bleach
- Remove used perlite and soil

At the end of the day:

- Clean up pots and trays under tables
- Remove unused clean soil from potting table
- Put things away in their storage places
- Remove rubbish
- Store used perlite and soil in closed bags



Always:

- Wash used pots and trays and utensils in diluted bleach, vinegar or detergent
- Keep cigarettes and food away from production areas
- Separate recycling
- Compost left over food and seed flesh into the worm farm or composting bin
- Compost, water soak and rot or burn infected plant parts quickly

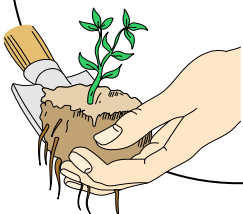


Image credits

Plant Photos unless otherwise stated taken by Peter Saunderson as part of the TIN collection.

Front cover and corner plant hands, page 13,14,18,19,21,Clipart Source is "10,000 Graphics Pack Vol 3" Kudo CD

Clipart unless stated otherwise by Microsoft

Page 5 Osmocote <http://www.scottsastralia.com.au/Osmocote>
Osmocote_Native_Gardens

Page 13 Seed tray http://www.thegardensuperstore.co.uk/acatalog/Seed_Trays.html

Page 19 Clonex <http://www.yates.com.au/Products/BooksToolsIrrigation/Propagation/ClonexPurpleRootingHormoneGel.asp>

Page 20– Cuttings http://gardening.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=gardening&cdn=homegarden&tm=8&f=00&su=p284.8.150.ip_&tt=29&bt=0&bts=1&zu=http%3A//www.ces.ncsu.edu/depts/hort/hil/hil-8702.html

Page 21 Secateurs <http://www.global-garden.com.au/felco.htm>

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Page 22 Plant labels http://www.greenharvest.com.au/tools/plant_labels_and_tags_prod.html

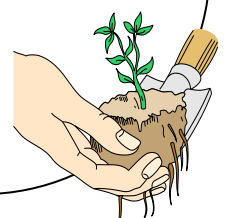
Page 23 PH Scale: http://images.google.com.au/imgres?imgurl=http://upload.wikimedia.org/wikipedia/commons/thumb/4/46/PH_scale.png/639px-PH_scale.png&imgrefurl=http://commons.wikimedia.org/wiki/Image:PH_scale.png&h=600&w=639&sz=135&hl=en&start=8&um=1&tbnid=ozHTSd6ikc0-FM:&tbnh=129&tbnw=137&prev=/images%3Fq%3DpH%2Bscale%255C%26um%3D1%26hl%3Den%26client%3Dfirefox-a%26rls%3Dorg.mozilla:en-US:official%26sa%3DN

Page 24 Tubes <http://www.gardencityplastics.com/propagation.htm>

Page 24 Hiko <http://www.stuewe.com/products/hiko.html>

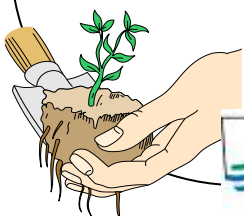
Page 28 Plant clump www.richters.com/.../demo5.html&&cart_id=111.100

Page 37 Compost <http://www.torfaen.gov.uk/EnvironmentAndPlanning/RubbishWasteAndRecycling/Composting/Images/How%20Compost%20Happens.gif>



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