WET TROPICS
Restoration Alliance

Outcomes report: Wet Tropics Nursery Production Workshop

15 August 2025

working together to protect and restore

Contents

Executive summary and introduction 3

Background 5

Learnings from community-based Wet Tropics nurseries 6

- Nursery challenges 6
- Being adaptable to balance priorities 7
- Creating and utilising a database for tree production 8
- Rooted in community, certified by nature: the ClimateForce organic nursery story 10
- The importance of record keeping in a revegetation nursery 11
- Nursery dispatch standards for revegetation seedlings, a perspective from a customer and producer 14

Other aspects of seedling production 15

- Seed storage 15
- Forecasting seedling production requirements 18
- Seed sourcing strategies 18

Permits and seed collecting guidelines 20

- When is a permit required? 20

Opportunities for nursery collaboration 21

Useful resources and references 24

Glossary of terms 25

Executive summary and introduction

Locally based nurseries are crucial for providing plant species suitable to restore forest habitats and create connections for wildlife.

Across the Wet Tropics there are at least 17 nurseries that produce seedlings primarily for restoration. This includes Landcare and conservation-led plant nurseries[1], local government, First Nations (Ranger) groups and one private service provider nursery to support revegetation of local ecosystems and foster community connection to the land.

With the emerging nature repair[2] (carbon trading and biodiversity) markets, designed to deliver high-integrity biodiversity outcomes and increase investment in nature, the demand for quality seed and seedling supply is increasing; and the success of restoration plantings pivots on the entire set of practices from seed collection to the point at which seedlings are delivered to field sites for planting.

In August 2025, the Wet Tropics Restoration Alliance[3] hosted a workshop to discuss nursery areas associated with seedling production for restoration projects.

The workshop objectives were to share knowledge; identify opportunities to collaborate; and outline information gaps that could be addressed to ensure there are no barriers to supplying sufficient seed stock and seedlings suitable to support scaling up restoration across the Wet Tropics region.

This report provides a summary of the outcomes of the day and recommends five issues to support on-going effort:

1. *The development of Wet Tropics nursery production guidelines.* Nursery production requires structured planning, infrastructure, strict hygiene, pest and pathogen management, record keeping, and a focus on high-quality seedling output. There are existing handbooks and guidelines available (online or other) however, they often focus on temperate, commercial or forestry nurseries, and do not adequately address issues faced in the tropics and the diverse range of wet tropics species used in restoration.
2. *Opportunities for nursery managers and staff to seek technical advice for troubleshooting nursery production issues.* This may include an online platform, practical forums and workshops where people can tap into expert technical advice. These should be professionally led, hands-on and relevant to local issues. This

[1] Excluding commercial nurseries/retail centres and private nurseries (six local government nurseries: Cairns Regional Council, Douglas Shire Council, Tablelands Regional Council, Cassowary Coast Regional Council (Innisfail and Tully) and Hinchinbrook Shire Council. Seven Landcare and conservation-led nurseries: Kuranda Envirocare, Mulgrave Landcare, Johnstone Region Landcare, C4, TREAT, ClimateForce and Rainforest Rescue. Seven First Nations groups: Girringun, Jaragun Ecoservices and Jabalbina Yidingi Aboriginal Corporation. One restoration service provider nursery: NQLMS).

[2] Nature Repair Market

[3] The Wet Tropics Restoration Alliance is a coalition of organisations and individuals with the shared goal of ensuring the survival of the Wet Tropics of Queensland forests amidst this changing and unstable climate.

would support best practice across the region and create capacity and skills to increase seedling production and support groups wanting to start up their own nursery.

3. *Clear and succinct information on seed collection regulations in the Wet Tropics*. There are many resources including guidelines, fact sheets, and codes of practice around legislative requirements for seed collecting to ensure there is minimal impact on wild populations. A concise summary of these materials (with links and examples of when they are applicable) will provide clarity to the restoration community.
4. *Collaboration on seed collecting across the region*. Scaling up restoration efforts across the Wet Tropics has increased the demand for suitable, quality, native seed for seedling production, and seed shortages are a serious bottleneck in restoration. Developing a register of suitable seed collection areas and willing landholders will increase potential collection sites. A seed and/or seedling exchange program and regional seed collectors would ensure a more regular supply of seed.
5. *Revegetation information to support climate change readiness and adaptation*. Ecological restoration can be compromised if projected climate change effects are not incorporated into restoration. Seed sourcing strategies that consider climate-adjusted provenance[4] for ecological restoration are a way to hedge against future climate uncertainty. This involves providing information on how to incorporate seed sourced from locations representing future climatic conditions.

Further scoping is required to understand what existing financial resources could be directed towards these areas and which activities would need to seek additional funds to progress.

[4] Seed provenance refers to the original geographic location or native habitat from which seeds are collected, determining their genetic adaptation to specific environmental conditions.

Figure 1. Some of the participants at the nursery production workshop, August 2025 / Wet Tropics Images

Background

The workshop held at the Nintiringanyi Cultural Training Centre in Gimuy (Cairns) on Friday 15 August 2025 brought together 54 participants from across the Wet Tropics region to discuss all aspects related to seedling production.

The purpose of the gathering was to share knowledge about nursery production processes and identify information gaps and opportunities where participants can work together to ensure that seedling production and supply are not a limiting factor for scaling up revegetation across the Wet Tropics region. The workshop was broken into two sessions. In the morning session, representatives from six different local nurseries presented information about their nursery processes, planning and data collection. The afternoon session provided information about seed storage, forecasting of seedling production and seed collecting strategies.

There were two interactive activities held during the day where workshop participants divided themselves into groups to discuss the types of nursery information that could be shared and opportunities for collaboration that would assist nurseries with seedling production.

The discussion focused on three topics:

1. What nursery production information would be useful to share?
2. Are there any current information gaps?
3. How can community-based nurseries best collaborate in these areas?

Learnings from community-based Wet Tropics nurseries

Nursery challenges

Ms Rachel Platte, Mulgrave Landcare coordinator

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The Mulgrave Landcare nursery is in Gordonvale and produces approximately 20,000 to 25,000 trees (Supa tubes[5]) annually. The nursery is on leased land with temporary nursery infrastructure and is supported by six to ten (depending on time of year) dedicated volunteers, a nursery manager and partners with the local Madjandji rangers who provide the nursery with locally sourced seeds. The nursery operation faces several challenges including:

- shading from adjacent trees which affects seedling health and growth rates
- the propagation area (seed trays) and the hardening area (potted trees) are on the same irrigation schedule; therefore, the water volume seed trays receive cannot be controlled – this impacts germination success and encourages moss growth
- potting media consists of mill mud and sand (very economical at ~$400/8m3 excluding GST) which is very dense but appears to contain a lot of nutrients because it still produces good trees
- browsing from pest and native species has a major impact, especially the native four-o-clock moth (*Dysphania numana*) whose host plant is Carallia brachiate, and
- impact from pathogens, particularly the exotic fungus, myrtle rust (*Austropuccinia psidii*), which has had a major impact in the nursery, particularly the trees and shrubs in the Myrtaceae family, including Melaleuca species which are a major component of local vegetation communities and restoration projects in the local area.

Figure 2. Mulgrave Landcare nursery / Wet Tropics Images

[5] A Supa tube is a plant pot designed specifically for nurseries to propagate seedlings and is typically 70mm x 70mm and around 160mm deep compared to the smaller forestry tube which is 50mm x 50mm x 120mm deep.

Being adaptable to balance priorities

Mr Ryan Zihrul, Cairns Regional Council nursery manager

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The priority of the Cairns Regional Council (CRC) revegetation nursery is to produce plants, maintain plant health and treat issues when they arise. Regular nursery activities involve tree orders, production and maintenance. All three activities are considered and placed in order of priority. The day always starts with a walk through the nursery to check on the plants and identify any issues, such as dry spots, pests, diseases or weeds, which need to be fully assessed and dealt with. A plan of weekly activities can then be put together outlining when to do maintenance, which species to be added to production, and any issues identified during the morning walk through.

Myrtle rust is taken very seriously[6] and there is a 'zero tolerance' approach when it reaches the stage of yellow spores to minimise the risk of spreading[7]. Once spores develop plants are binned. Special methods used to minimise myrtle rust impacts on Myrtaceae species include:

1. placing susceptible Myrtaceae species in drier parts of the nursery (myrtle rust prefers warm, moist and humid conditions) to encourage leaves to toughen up (i.e. minimise amount of soft green shoots)
2. using a special potting mix for Myrtaceous species (e.g. no Osmocote for *Melaleuca* spp.), and
3. potting up *Melaleuca* spp. before summer so plants are bigger and there are less soft new shoots (that is, potting between March and May).

General hints and recommendations

- If picking trees for an order, use the opportunity to check stock levels at all ages of growth.
- Keep up with maintenance.
- Prune lower leaves hard to ensure nutrient uptake at apical growth, optimal airflow and water penetration.
- Keep and maintain accurate records.
- Understand how myrtle rust spreads, learn how to control it.
- Stagger batches when potting to allow for maximum species diversity at any one time. Use herbarium resources for plant identification such as the Australian Tropical Rainforest Plants identification key.

[6] Myrtle rust is listed under the *Environment Protection and Biodiversity Conservation Act 1999*(EPBC Act) as a part of the 'Novel biota and their impact on biodiversity' Key Threatening Process.

[7] Refer to Business Queensland: Myrtle Rust or Department of Agriculture, Fisheries and Forestry for more information.

Creating and utilising a database for tree production

Ms Samantha Wingrove, Rainforest Rescue nursery manager

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Rainforest Rescue has recently built a new, native nursery at Cow Bay[8], which has capacity to produce up to 150,000 trees/annum. Trees are grown to order on a project-by-project basis for specific sites. Seeds are collected from multiple fruiting trees per species and a maximum of 20% of the fruiting crop is collected per tree following the Florabank Guidelines (Florabank Model Code of Practice) for best practice. The Global Positioning System (GPS) locations and fruiting times are recorded for seeds collected.

The nursery species database contains all relevant data for each species grown in the nursery to date including successional stage, growth rate, height, distribution and habitat and description for identification. Propagation data are also recorded and includes seed treatments, sowing methods, germination times and germination success. This information has been gathered over time through lots of trial and error and is applied to species within the same or a similar genus.

There is a designated shadehouse area where seedling trays can be stored for future production (one to two years). The seedlings to be stored are sown into a cocopeat mix[9] with low nutrients. This is currently the best method of storage for recalcitrant seeds (seeds that are desiccation-sensitive and cannot survive drying out). Some seed storage techniques are also being trialled.

Seedlings are planted in a fertilised media, primarily in forestry tubes (50mmx50mmx120mm) and grown to order for scheduled projects. Growing to meet plant orders allows better management of plant production so that plants are optimal size when needed for the project and prevents having excess stock leftover in the nursery. Potted plants are transferred to the shadehouse under 50% shade cloth then transferred later to 30% shadecloth to start the hardening process before being moved to the hardening area in full sun. The production journey is logged for each species in the database and growth is monitored to determine the dispatch dates.

[8] Rainforest Rescue Native Nursery

[9] Cocopeat is a natural, sustainable growing medium from coconut husks, used as a soil conditioner or potting mix component to improve water retention, aeration, and root growth, ideal for most plants but not a fertilizer itself, offering an eco-friendly alternative to peat moss. It is lightweight, retains moisture like a sponge, breaks up clay, and provides oxygen for roots, making plants healthier.

The nursery has not used any pesticides for over 18 months. Beneficial local insects and mites are used to help manage infestations. Mites have been the biggest pest issue to date in the nursery. Ten-spotted ladybug are brought into the nursery to feed on the mites (ladybug eggs are purchased online from 'Bugs for bugs'[10]). Species that are very susceptible to myrtle rust are not typically grown. Increasing plant spacing for better air flow helps with plant health.

All nursery production data is collected electronically in the nursery via Jotform[11] which reduces the data entry time required and helps to minimise errors.

General hints and recommendations

- Size grading of plants in the nursery is very important to allow for adequate light, water and air around each seedling – our biggest losses occur when we do not size grade.
- Record all potting information (losses, growth rates, etc.) this is vital for efficient nursery production management.
- Reduce pests and diseases in the nursery where possible.
- Focus on core species that are always required for restoration projects.
- Pre-order and plan for scheduled projects.

Figure 3. Rainforest Rescue's native nursery at Cow Bay / Rainforest Rescue © Martin Stringer

[10] Bugs for bugs ™ is an Australian supplier of biological control agents (beneficial insects and mites) for controlling pests without harmful pesticides.
[11] Jotform ™ is a platform to create online forms and mobile apps for data collection and streamline processes without coding.

Rooted in community, certified by nature: the ClimateForce organic nursery story

Ms Liana Toth, ClimateForce nursery manager

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The team at ClimateForce[12] are pioneering organic regeneration practices in the Wet Tropics for all nursery and land management practices. The nursery is located on their property north of the Daintree River, a 527-acre property that was previously an organically certified banana farm. The organic certification has been upheld; therefore, the organic ethos is applied to all nursery practices and fresh produce/tree sales.

Development of the nursery and its procedures have evolved with time since they commenced in 2021. Nursery production knowledge was built from scratch through books, completing workshops in plant identification (Australian Tropical Herbarium), best practice guidelines (Florabank), visiting local nurseries and through trial and error.

Staff and volunteers aim to grow a high diversity of plant in the nursery to improve diversity in the soil and are learning which local species work best in plantings to achieve fast-paced canopy closure and smother out weeds.

ClimateForce have a 'Seed to Canopy Journey' where all stages from collection, propagation and planting of a seed are captured and tracked in Survey 123 through ESRI[13]. Information recorded includes GPS coordinates, date, species, number of seeds and a batch ID to track the journey. This data entry system is prone to human error; however, this hopefully could be minimised in the future by upgrading to a Radio Frequency Identification (RFID) batching system.

General hints and recommendations

- Be aware of plants that have hairs or caustic sap (such as *Davidsonia pruriens* and *Semecarpus australiensis*) before collecting and processing.
- Seed collecting activities are guided by the Florabank guidelines.
- Organic practices for pest and disease are focused on prevention.
- Mulching (sugar cane mulch) within the seedling trays helps minimise weeding.
- Use of aluminium mesh cages to enclose seedlings to prevent rodent damage.
- Biosecurity practices are important to implement (for electric ants).
- Do not store trees for too long in nursery as this increases the risk of plant health issues and increases (plant maintenance) costs.
- Space trees in nursery for good air flow.

[12] ClimateForce

[13] ESRI is a Geographic Information System (GIS) software that is used to create, manage analyse mapping and spatial data.

- Hardening area has two shade area sections: 70% and 30%.
- Volunteer support is crucial for time consuming jobs like seed processing and weeding.

Figure 4. ClimateForce's 527-acre property in Kimberley / ClimateForce

The importance of record keeping in a revegetation nursery

Dr Dinah Hansman, Trees for the Evelyn and Atherton Tablelands (TREAT)

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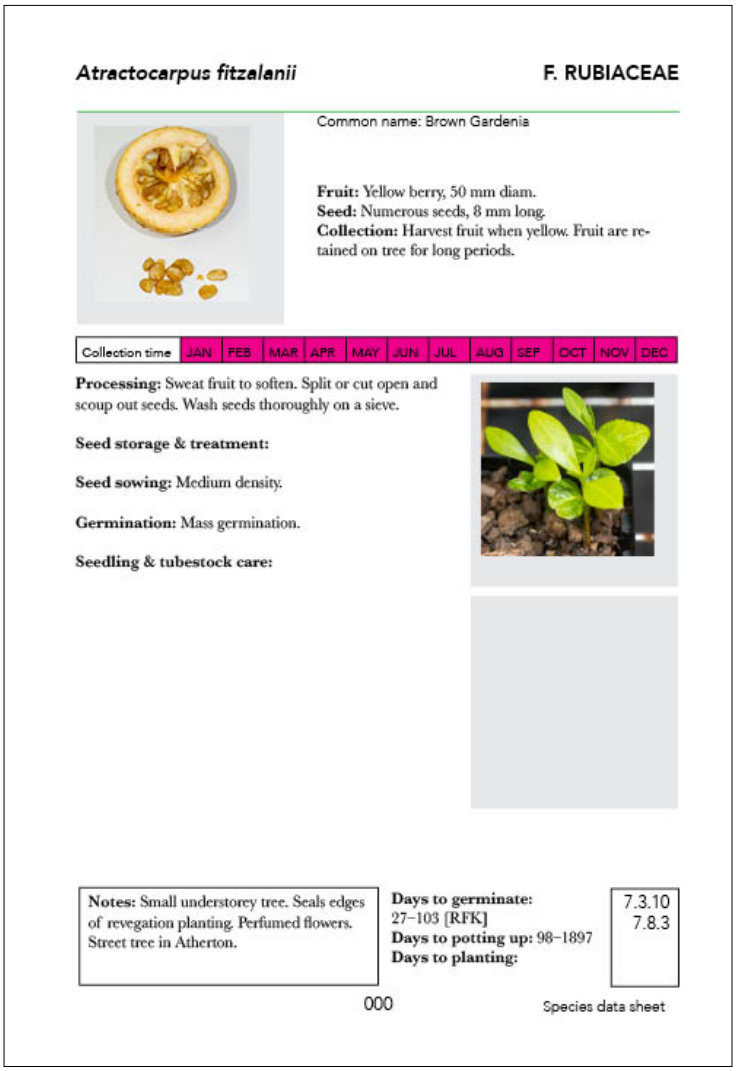
TREAT, a volunteer revegetation organisation on the Atherton Tablelands works under a Memorandum of Understanding with Queensland Parks and Wildlife Service (QPWS) and operates out of the Lake Eacham nursery. They have been operating for over 40 years with a current membership of over 400 households. TREAT volunteers assist with nursery activities each Friday morning at the Lake Eacham QPWS nursery.

TREAT operates under the premise of 'the right tree in the right place for the right reason' to maximise successful planting outcomes. Seedling production is planned to be

efficient (i.e. seed, propagation materials, time and space). This involves creating a 'shopping list' of species required for their upcoming projects and includes species that are fit for purpose and sourced according to Regional Ecosystems. Therefore, seed is collected from vegetation communities in the bioregion with similar climate, soil, geology, landform and rainfall characteristics of the project sites.

Record keeping is crucial for efficiently managing a revegetation nursery. For example, recording GPS coordinates of fruiting tree locations and the seed collected enables mapping of seed collecting trips and ensures the same trees are not collected from constantly. Tags with information about that plant (species ID, collection location, dates) follow the seed all the way through the nursery. The nursery keeps records for seed collection, potting, sowing and time to germination.



Atractocarpus fitzalanii **F. RUBIACEAE**

Common name: Brown Gardenia

Fruit: Yellow berry, 50 mm diam.
Seed: Numerous seeds, 8 mm long.
Collection: Harvest fruit when yellow. Fruit are retained on tree for long periods.

Collection time	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Processing: Sweat fruit to soften. Split or cut open and scoup out seeds. Wash seeds thoroughly on a sieve.

Seed storage & treatment:

Seed sowing: Medium density.

Germination: Mass germination.

Seedling & tubestock care:

Notes: Small understorey tree. Seals edges of revegation planting. Perfumed flowers. Street tree in Atherton.

Days to germinate: 27–103 [RFK]
Days to potting up: 98–1897
Days to planting:

7.3.10
7.8.3

000

Species data sheet

Figure 5. TREAT information sheet for brown gardenia (*Atractocarpus fitzalanii*) / TREAT

Detailed information is also being compiled for individual species (refer Figure1). There is much information that takes time to accumulate and is often in people's heads. We need to record this so people do not have to re-discover it and to prevent making the same mistakes of the past. Such information includes:

1. collection - when is it ready, bagging
2. processing - fruit removal, care needed
3. treatment - soaking, boiling water
4. sowing - mix, density, slow release, slugs, rats
5. germination - how long, timing
6. storage - how long, and
7. seedling and tubestock care - fertiliser, pruning, shade.

This is valuable information that creates efficiencies particularly when there are many volunteers and/or a high turnover of staff.

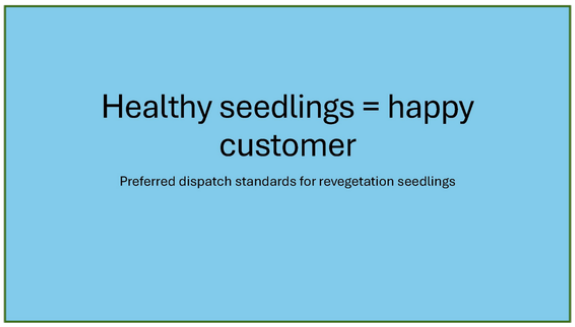
General hints and recommendations

- Don't waste resources on growing vines, understorey, weedy and difficult species.
- Don't collect all seeds from the same source tree, as this will reduce genetic diversity.
- Where there is a high turnover of staff and /or volunteers the record keeping system must be robust.
- Record where seed was collected (take a photo with smartphone-will have GPS info if location is turned on).
- Allow sufficient time from fruit collection to planting.
- Identification is not essential – planting trees in location sourced is more important than identifying the plant (providing the tree is known to be a native species).
- Seeds that are slow to germinate have a green label placed in the tray with how long it might take – so they're not thrown out prematurely.
- Information on TREAT's propagation and planting techniques is available on the website.
- Don't let the tail wag the dog, use your records to plan and make best use of time, seed and money.

Figure 6. TREAT's nursery in Lake Eacham / Wet Tropics Images

Nursery dispatch standards for revegetation seedlings, a perspective from a customer and producer

Mr Geoff Onus, CEO North Queensland Land Management Services (NQLMS)



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NQLMS offer a range of land management services with experience in large scale revegetation across the Wet Tropics landscapes. From the NQLMS perspective, there is a crucial need for guidelines that outline acceptable standards for the supply of revegetation seedlings. This will help ensure that the investment of resources required to reinstate native vegetation is not jeopardised by inadequate seedling dispatch. Healthy seedlings help ensure successful revegetation projects.

Nursery despatch standards should apply to all nurseries that supply seedlings for restoration projects, even those that do not sell seedlings to the general public. This also includes the supply of seedlings by an organisation to their own projects.

Experience planting many thousands of trees across the Atherton Tablelands over many years has provided evidence of when the quality of seedlings supplied is unlikely to survive when planted in the field. The most crucial aspect of producing quality seedlings for despatch is timing. Seedlings should:

- have a minimum height of 300mm (not including tube), ideally greater than 400mm
- have roots that hold the potting mix
- be sturdy, not floppy
- be sun-hardened (ensure enough time for this)
- not be too old, root-bound, sick or unhealthy in appearance.

General hints and recommendations

- Healthy seedlings = happy customers.
- Super tubes are preferrable to the smaller forestry tubes, but tube size does not matter if seedlings meet the above-mentioned standards.
- Select seedlings individually from all available stock, don't just grab whole trays off a bench.
- The timing of plant production (sowing seeds and potting up) is crucial
- Dispose of old, unhealthy stock.
- Double/triple space seedlings, if possible (to allow for adequate airflow and irrigation).
- Top dress[14] and manage disease.

[14] "Top dress" means to apply a thin layer of blended material (like compost, sand, or soil) to improve soil health, level uneven spots, and create a thicker, lusher, and more resilient surfaces by enriching nutrients and improving drainage.

Other aspects of seedling production

Ms Kylie Freebody, Wet Tropics Restoration Alliance coordinator

Seed storage

The seed of many Wet Tropics species can be stored as seedlings in trays typically for one to two years. However, the ability to store seeds for longer periods reduces the risk of having no seed during several consecutive non-fruiting seasons, can add to the genetic diversity, and provides the ability to sow additional seeds if there is an increased demand for supply between fruiting seasons.

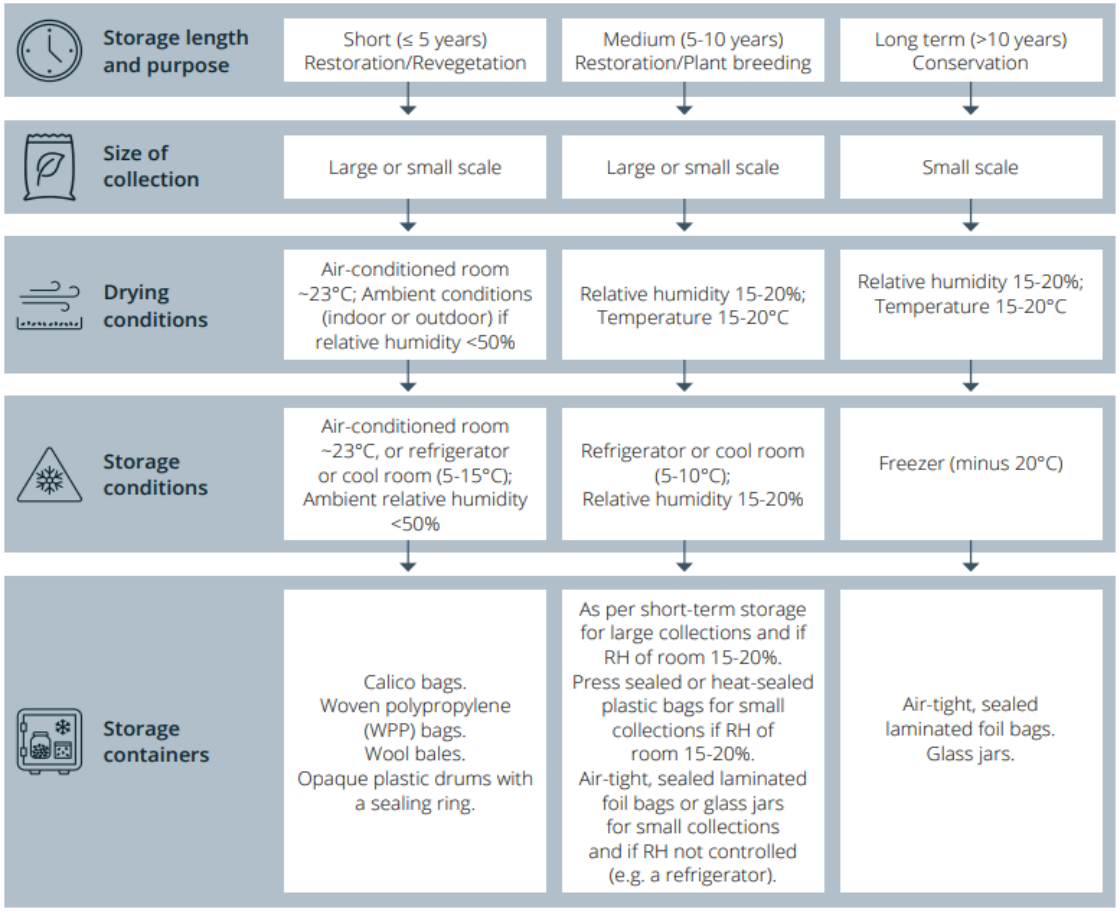
Recent research on Australian rainforest plants shows that over 40% of tree species have seeds that are sensitive to desiccation and are relatively short lived and therefore cannot be stored using accepted seed storage methods[15]. These types of seeds are termed recalcitrant and have a high moisture content when shed. Some examples of recalcitrant seeds include many *Syzygium* spp. and members of the Sapindaceae family.

Seeds are usually tolerant of drying if they have a hard and impermeable seed coat (e.g. *Acacia* spp. and *Alphitonia spp.*). However, many other species commonly used in restoration projects can also be stored successfully for the short to medium term (one to five years) in a domestic fridge, provided the moisture content of the seed is reduced before storage.

Most species fruit during the wet season when the humidity is high, so the best way to dry seed in the tropics is in an air-conditioned room (~23°C) for one to two days. If relative humidity (RH) was below 50%, seed could be dried at ambient temperature. After drying, seed should then be fully labelled then packaged and stored in the fridge (~5°C) in airtight containers (resealable bags, plastic containers or glass jars). Containers must be airtight to ensure that moisture is not reabsorbed into seeds from the surrounding air. Domestic fridges are not humidity-controlled and may have an RH of 90% so it is a good idea to put a silica gel packet inside the containers to absorb any moisture. These need to be checked and replaced occasionally.

[15] See Sommerville et al.(2021) Assessing the storage potential of Australian rainforest seeds: a decision-making key to aid rapid conservation and Sommerville et al.(2023). Are orthodox Australian rainforest seeds short-lived in storage?

Figure 7. Seed drying, packaging, and storage conditions (temperature and relative humidity appropriate to seed collections of differing scale and purpose[16].



Several genera that have dry winged species can be successfully stored for at least four years. This includes genera within the families Proteaceae (*Buckinghamia* spp., *Lomatia* spp., *Stenocarpus* spp., Myrtaceae (*Xanthostemon* spp.), Rutaceae (*Flindersia* spp.) and Cunoniaceae (*Karabina* spp. and *Ackama* spp.). Some success has also been achieved storing recalcitrant species in the fridge for periods ranging from three to 24 months. Although this is not a long time, maintaining seed viability for extended periods enable seed sowing to be staggered, allowing the nursery to manage seedling tray production more efficiently. This is handy when the nursery production requirements for the next planting season are uncertain.

The most important considerations when experimenting with seed storage is the moisture content of seed before and during storage. Regularly check fridge stored seed. Check fleshy seeds monthly for signs of fungus or rotting, and dry seeds every two to three months.

[16] Figure sourced from Florabank Guidelines Module 9 Seed Drying and storage.

Table 1. Seed storage periods for rainforest species commonly used in plantings on the Atherton Tablelands (unpublished data, K. Freebody) (yrs = years, mths = months)

Family	*Genus*	Seed storage period	Fruit type	General seed moisture description
Myrtaceae	*Eucalyptus*	20yrs	nut	dry
Myrtaceae	*Lophostemon*	20yrs	capsule	dry
Myrtaceae	*Xanthostemon*	5yrs	capsule	dry
Casuarinaceae	*Casuarina*	20yrs	capsule	dry
Casuarinaceae	*Allocasuarina*	20yrs	capsule	dry
Rhamnaceae	*Alphitonia*	8yrs	drupe	dry
Fabaceae	*Acacia*	8yrs	pod	dry
Myrtaceae	*Melaleuca*	8yrs	capsule	dry
Proteaceae	*Buckinghamia*	5yrs	follicle	dry
Proteaceae	*Lomatia*	5yrs	follicle	dry
Proteaceae	*Stenocarpus*	5yrs	follicle	dry
Cunoniaceae	*Karabina*	3-4yrs	capsule	dry
Cunoniaceae	*Ackama*	3-4yrs	capsule	dry
Anacardiaceae	*Blepharocarya*	3-4yrs	capsule	dry
Apocynacaeae	*Alstonia*	3-4yrs	follicle	dry
Rutaceae	*Flindersia*	3-4yrs	capsule	dry
Meliaceae	*Toona*	3-4yrs	capsule	dry
Moraceae	*Ficus*	3-4yrs	fleshy	dry
Rutaceae	*Melicope*	1-2yrs	capsule	fleshy
Euphorbiaceae	*Homalanthus*	1-2yrs	capsule	fleshy
Fabaceae	*Castanospermum*	1-2yrs	follicle	fleshy
Combretaceae	*Terminalia*	1-2yrs	fleshy	dry
Fabaceae	*Pararchidendron*	1-2yrs	follicle	fleshy
Myrtaceae	*Syzygium kuranda, S. australe, S. gustavoides*	3-12 mths	fleshy	fleshy
Lauraceae	*Cryptocarya oblata, Endiandra sankeyana*	3-12 mths	fleshy	fleshy
Sapindaceae	*Diploglottis bracteata*	3-12 mths	capsule	fleshy

General hints and recommendations

- Use a percentage of stored seed each year so that stock is rotated and replenished as required.
- Maintain records of seed storage, sowing and germination success to track viability over time.
- Seed viability will reduce over time so discard seeds when viability becomes too low (and therefore germination will be very low).
- Refer to the Florabank Guidelines Module 9 Seed Drying and storage for guiding principles.

Forecasting seedling production requirements

The size, capacity and purpose of nurseries vary greatly across the region. A nursery that grows plants solely for their own projects has control over the annual seedling numbers required and the timing of production. In contrast, nurseries that rely partially or solely on external projects to support staffing levels and seedling production are often unable to accurately predict advance seedling requirements and therefore have less control over the timing of production.

To help with nursery production 'crystal ball gazing' consider what level of risk the nursery can cope with in producing seedlings excess to requirements. Are there sufficient funds, materials (potting media, pots, etc.), nursery space and labour to produce extra seedlings? When customers place an order for large numbers of seedlings (for example, 200 seedlings and above) request a deposit payment for them to secure their order. The deposit is forfeited if the order is not picked up. This helps fund seedling production in advance and helps the nursery to determine their total seedling production target.

Good nursery production planning is the key to supplying healthy, sun hardened seedlings at their optimum size for planting out in restoration projects. Production planning also helps minimise having old, overgrown seedlings in the nursery. Plan a potting schedule so seedlings are ready for planting out at times that coincide with tree orders and key planting times. Also, stage the potting-up of an individual species throughout the production period to avoid having all plants of one species ready at the same time.

General hints and recommendations

- Consider the potential seedling requirements in advance and collect amounts accordingly.
- Align seed collection with potential seedling requirements.
- Grow 'bread and butter' species commonly used (especially if growing excess to requirements).
- Sow extra seeds and store as seedling trays and store seeds where possible.
- Keep nursery records - these are the key to good nursery production.
- Use nursery seedling growth rate data as a guide for when to pot up, and
- Discard old and unhealthy stock.

Seed sourcing strategies

In the 1990s it was commonly believed that 'locally' collected seeds (local provenance) are best for restoration projects, based on the principle that seed collected from local populations is better adapted to local conditions and seeds from the wrong provenance may lead to poor plant survival, reduced growth, and limited success in restoration efforts.

In the last decade there has been pushback to local provenancing, arguing that for plantings to be resilient to climate change they must contain species that are not only adapted to the local geology, climate and soil, but to future conditions. This has led to the development of four seed sourcing strategies[17], briefly outlined below.

1. *Local provenance* - sourcing seeds from plants geographically close to the restoration site.
2. *Composite provenance* - mixes seeds from local sources with smaller amounts from more distant, climatically suitable regions to boost genetic diversity and adaptability.
3. *Predictive provenance* - seeds are collected from locations that currently match the predicted future climate conditions of the restoration site, and
4. *Admixture provenance* – involves mixing seeds from a wide variety of sources across a species' range to maximize genetic diversity in the restored population.

Strategies 3 and 4 are more complex and incorporate provenance data with predicted future climate scenarios using climate modelling.

As restoration practitioners in the Wet Tropics, how should we source seed to achieve resilient, long-term self-sustaining plant populations? Particularly when there is limited or no available genomic and climatic data and there is no evidence that describes what provenance is for the Wet Tropics region. Are we unnecessarily restricting our seed collection? To address these concerns, we need to find a balance and use sensible guidelines.

General hints and recommendations

- Always aim to collect from several different trees within a species, even for pioneers and commonly occurring species.
- Consider incorporating far wider seed collecting areas for broadly distributed species to incorporate greater diversity and long-term resilience.
- Where possible include plants from different seed sources (for each species) in each planting.

[17] See the following papers: Breed et al.(2013) Which provenance and where? Seed sourcing strategies for revegetation in a changing environment and Fahey et al. (2025) Defining species-specific seed sourcing strategies for restoration: an example of how to use genetic data to inform seed collections for multiple co-occurring species

Permits and seed collecting guidelines

All plants indigenous to Australia are considered protected under the *Nature Conservation Act 1992 (Qld)*. Those native plants that are **threatened** or **special least concern species** are termed **protected plants** and permits are required for collecting them in the wild under the *Nature Conservation (Plants) Regulation 2000 (Qld)*[18].

All other least concern plants are exempt from requiring a licence for the harvesting of whole plants or plant parts. These regulations do not apply to protected plants that are not in the wild.

When is a permit required?

Permits are required for collecting from protected areas, for example national parks, nature refuges, conservation parks and special wildlife reserves. A protected plant that has been propagated and established through human intervention would not normally be considered to be in the wild (e.g. a tree planted in a public recreation park). However, protected plants established in revegetation sites that may have reached a relatively self-sustaining state or in an offset project may be considered in the wild.

There are special exemptions for the collection of protected plants (from protected areas in the wild) when permits are not required. This includes:

1. voucher specimens for research purposes[19], and
2. specific quantities of seed and propagating material which can be taken from all protected plants in the wild excluding Critically Endangered and Endangered (see section 2.3.1.2 of the *Code of Practice For the take and use of protected plants Nature Conservation Act 1992)*

Consent of a landholder must be sorted prior to using the available exemption to take and use the protected plants.

If exemptions do not apply, then an application must be made for a protected plant licence. This is the collective term used to refer to the two types of licences for harvesting and growing protected plants. A sustainable harvest plan is also required, and application fees apply.

[19] To determine if a plant is a Threatened or Special Least Concern species, type the species name into https://wildnet.science-data.qld.gov.au/species-search and it will list the conservation status under the *Nature Conservation Act 1992* (NCA).

[19] Voucher specimens under the *NCA* in Queensland are permanently preserved, catalogued, and curated biological samples (plants, animals, or fungi) that serve as verifiable, permanent records of species in a specific location. They are required to authenticate species identification in scientific studies, particularly in surveys for threatened or near-threatened species.

It is advisable to seek advice through a pre-lodgement meeting before submitting an application. This can be done by making a request to the Wildlife Permits mailbox wildlife@detsi.qld.gov.au .

Opportunities for nursery collaboration

During the group sessions participants discussed the types of nursery information that could be shared and opportunities for collaboration to assist nurseries with seedling production. To focus conversations, the following topics were considered:

- What nursery production information would be useful to share?
- Are there any current information gaps?
- How can community-based nurseries best collaborate in these areas?

The table below summarises participants' feedback from both group sessions with general comments listed in the first column. Suggested actions to progress these ideas are provided in the second column, and any key gaps or barriers are listed in the final column.

Note that in session 2, groups focused their discussions on collaboration opportunities around nursery activities and seed collection. Nursery collaboration comments have been incorporated into the 'nursery knowledge to be shared' section of the summary table. Suggestions on knowledge sharing and collaboration for seed collection focused on providing more information about where to collect seed, exchanging seed and permitting issues.

The information provided by participants and listed in table 3 is focused on three key areas.

1. The creation of a nursery production manual, factsheets or quick guides
2. Development of a nursery forum or platform for asking questions and troubleshooting
3. Seed collection support.

Figure 8. Group sessions at the Nursery Production Workshop / Wet Tropics Images

Table 2. Summary of group session discussions.

Session 1 – Nursery knowledge to be shared		
1. What nursery knowledge can be shared? 2. Are there any information gaps or barriers? 3. List any suitable actions.		
General comments	**Actions**	**Information gaps/barriers**
- Seed collection (techniques and hints) - Seed/fruit processing and treatment techniques - Propagation and germination guide by species - Techniques for managing pests and diseases (wet tropics specific pest ID guide) - Myrtle Rust treatment techniques - Nursery hygiene practices - Results of experimental (nursery) trials - Potting mix recipes (cost effective and available materials) - Fertiliser - Water management/irrigation - Spacing of plants - Plant hardening methods - Timing of growth, growth rates - Single database format across the Alliance e.g. using JotForm	- Group visits to other nurseries within Alliance - Networking events - Share nursery trials/errors via Alliance newsletter (send in articles) - Create a nursery manual including seed collection, treatment, propagation, germination information etc by species - Chat groups for sharing information - Factsheets for specialty plants - Create quick guides like TREAT have started (e.g. pdf resources) - Collate all information into communal database (students) - Hire a regional adviser/expert for advice/troubleshooting for Alliance (e.g. website contact) - Create forum for local nurseries to ask questions - Provide rainforest identification training	- Forum where specific nursery related advice can be sought
Session 2 – Collaboration and seed collection		
1. What opportunities are there for collaboration? 2. What actions can be taken?		
General comments	**Actions**	**Information gaps/barriers**
- Seed collection	- Community local source input app for GPS coordinates - seed collecting	- Seed collection sites for

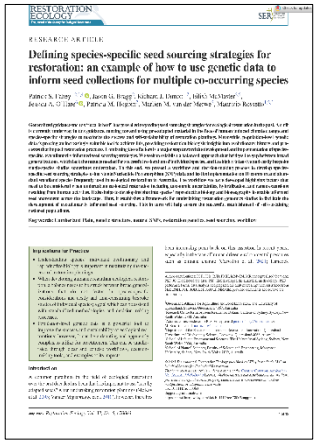
- Seed source locations (wiki type app)-so not all collect from same seed source - Exchange seed - Shared seed storage facility - Group collecting permit for Alliance nurseries - Share information about current (restoration-related) observations that relate to climate e.g. hotter, wetter, drier	- Opportunity for regional seed collector (as business) - Property registers for seed collection (Nature Refuges) - Record collections to avoid over-collection - Encourage use of Atlas of Living Australia (ALA) and I Naturalist	genetic diversity - Permits for access - Opportunity for regional seed collector (as business)

Further consideration is required to determine which actions and gaps shown in the table above can be progressed collaboratively through the Alliance network with existing capacity and which activities will require seeking additional resources.

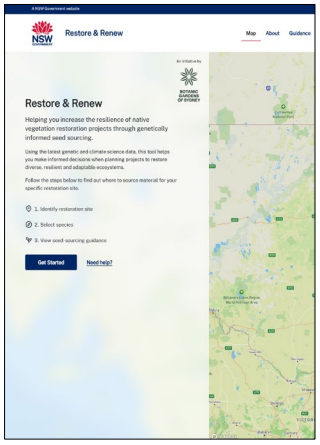
Figure 9. Seeds collected for a restoration project / Kylie Freebody

Useful resources and references

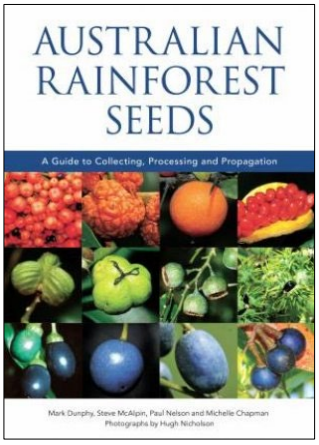
The following resources are provided as a starting point and are not an exhaustive list.



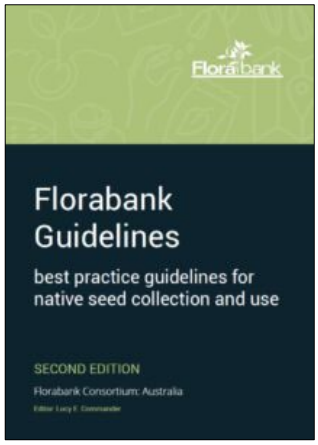
Smith, J., Brown, L., & Lee, K. (2021). *Defining species-specific seed sourcing strategies for restoration: an example of how to use genetic data to inform seed collections for multiple co-occurring species.* Restoration Ecology, 29(4), 123–135.



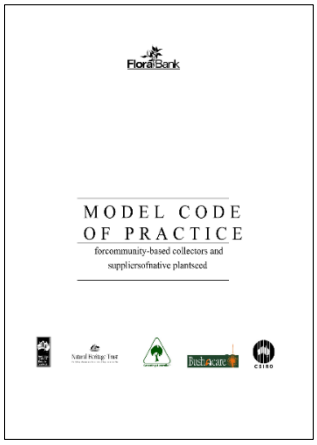
Research Centre for Ecosystem Resilience (ReCER) (Botanic Gardens of Sydney) *Restore and Renew project*. A decision support tool for genetically informed species restoration (has an environmental site matching tool).



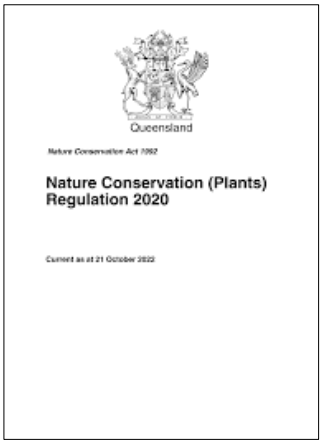
Dunphy, B., McAlpin, C., Nelson, D. & Chapman, R. (2020). *Australian Rainforest Seeds: A Guide to Collecting, Processing and Propagation.* CSIRO Publishing.



Florabank. *Florabank Guidelines: Best practice guidelines for native seed collection and use.* 15 modules following the seed supply chain.



Florabank. (late 1990s). *Florabank Model Code of Practice for community-based collectors and suppliers of native seed.*



Queensland Government. (1992). *Nature Conservation Act 1992.* Nature Conservation (Plants) Regulation 2020.

Glossary of terms

Term	Meeting
ALA	Atlas of Living Australia
CRC	Cairns Regional Council
C4	Community for Coastal and Cassowary Conservation
DETSI	Department of Environment, Tourism, Science and Innovation
ESRI	Environmental Systems Research Institute (geographic information system)
GPS	Global Positioning System
NCA	*Nature Conservation Act 1992 (Qld)*
NQLMS	North Queensland Land Management Services
PPGL	Protected Plant Grower Licence
QPWS&P	Queensland Parks and Wildlife Service and Partnerships
RFID	Radio Frequency Identification
RE	Regional Ecosystem
RH	Relative Humidity
TREAT	Trees for the Evelyn and Atherton Tablelands
WTMA	Wet Tropics Management Authority
WTRA	Wet Tropics Restoration Alliance

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