# Chapter 3: Setting Up a Small Low-Cost Culture Space

A plant tissue culture project does not begin with hormones or rare equipment. It begins with a place.

That place does not need to look like a university laboratory on the first day. Many beginner farmers start with a small room, a clean corner, a strong table, a pressure cooker, shelves, jars, labels, and strict habits. What matters most is not luxury. What matters most is control.

In the field, plants face wind, dust, insects, splashing water, fungi, bacteria, heat, and changing light. In tissue culture, the plant is tiny, soft, and placed on a sugar-rich medium. That medium is excellent food for the plant, but it is also excellent food for microorganisms. Because of this, the culture space must be designed to reduce contamination and to keep the young cultures in a stable environment. Contamination by bacteria and fungi is one of the common problems in plant tissue culture, and good facility design plus careful aseptic technique are central to reducing it (Leifert and Cassells, 2001; George et al., 2008).

This chapter will help you plan a small, low-cost culture space for learning and small farm-scale propagation. Later chapters will teach sterilization, media preparation, explant handling, multiplication, rooting, and hardening. Here we build the place where those skills can happen.

The main idea is simple:

A good beginner culture space separates dirty work from clean work, keeps cultures under steady light and temperature, gives workers a place to wash and organize, and makes records easy to keep.

## The purpose of a culture space

A culture space is the area where plant tissue cultures are prepared, transferred, stored, and observed. It may be one room divided into work zones, or it may be two or three small areas used for different tasks.

The culture space has four main jobs:

1. Keep clean work clean.

When an explant is placed into a culture vessel, the opening of that vessel is a weak point. Dust, breath droplets, dirty tools, or unclean hands can introduce microorganisms.

2. Protect the plant material.

Tiny explants dry out quickly, bruise easily, and may die if exposed to too much heat, chemical sterilant, or rough handling.

3. Support steady growth.

Cultures usually need suitable temperature, light, and day length. Many plant tissue cultures are incubated under controlled light and temperature, commonly around room-warm conditions, though exact needs vary by species and protocol (George et al., 2008; Bhojwani and Dantu, 2013).

4. Make the work repeatable.

A farmer must know which jar came from which mother plant, which medium was used, when it was prepared, and what happened afterward. Without records, success cannot be repeated and failure cannot be understood.

A beginner should not think, “How can I build a perfect laboratory?” A better question is:

How can I create a clean, organized, repeatable workflow with the resources I have?

## Clean does not mean sterile

Before planning the room, we need to define three important words: clean, sterile, and aseptic.

Clean means visibly free of dirt, plant debris, dust, spilled medium, and waste. A swept floor, wiped table, washed hands, and covered jars are clean. Cleanliness reduces the number of microorganisms, but it does not remove them all.

Sterile means free of living microorganisms such as bacteria, fungi, and spores. In plant tissue culture, media, tools, and containers are commonly sterilized by heat, filtration, or chemical treatment, depending on the material. Sterility is a stricter condition than cleanliness.

Aseptic means working in a way that prevents contamination from entering sterile materials. For example, a jar of medium may be sterile after pressure cooking, but it can become contaminated if you open it in dusty air or touch the inside with unsterilized forceps. Aseptic technique is the disciplined handling of sterile materials so they remain sterile during work (Smith, 2013).

A simple example makes the difference clear:

- A washed kitchen knife is clean.

- A scalpel heated or pressure-sterilized correctly may be sterile.

- Using that sterile scalpel without touching the blade to the table, your sleeve, or an unclean surface is aseptic work.

Your culture space must support all three: cleaning, sterilizing, and aseptic handling.

## Think in zones, not just rooms

A common beginner mistake is to put everything on one table: soil samples, mother plants, dirty explants, bleach bottles, clean jars, open cultures, notebooks, lunch, and mobile phones. This creates confusion and contamination.

Instead, think in zones. A zone is an area with one main purpose. Even in a small room, you can create zones by using separate tables, shelves, trays, boxes, or marked sections.

A small tissue culture setup usually needs these zones:

1. Entry and handwashing zone
2. Cleaning and washing zone
3. Media preparation zone
4. Sterilization zone
5. Aseptic transfer zone
6. Culture growth zone
7. Storage zone
8. Record and observation zone

Not every farmer will have a separate room for each zone. That is acceptable. The important rule is that the workflow should move from dirtier tasks toward cleaner tasks, not the other way around.

For example:

Mother plant material → washing → surface sterilization → clean transfer → culture shelf → records

Do not carry contaminated plant material over the culture shelf. Do not wash muddy tools beside open culture vessels. Do not store soil, compost, or nursery trays inside the same closed area where cultures are opened.

## Choosing the location

The best low-cost culture space is usually a small room that can be closed, cleaned, and controlled. It should be away from animal housing, compost areas, dusty roads, grain storage, pesticide mixing areas, and busy household traffic.

A suitable room has these qualities:

- It can be closed with a door.
- It has a smooth floor that can be swept and mopped.
- It has walls and surfaces that can be wiped.
- It is not damp or moldy.
- It is protected from insects, rodents, and lizards.
- It has access to clean water.
- It has electricity or a safe lighting option.
- It is not used for cooking, sleeping, or storing farm chemicals.
- It can stay reasonably cool and stable during the day.

A spare room, a small office, a converted store room, or a clean corner of a farm building may work. A kitchen is usually not ideal because cooking produces steam, oil droplets, food residues, and heavy movement. However, some beginners prepare media in a clean kitchen and do transfers in a separate cleaned box or small room. If this is done, food preparation and tissue culture work should be separated by time, cleaning, and storage.

The worst locations are those with dust, wind, animals, and soil. Tissue culture and soil should meet only later, during acclimatization in the nursery.

## The entry and handwashing station

Every culture space needs a clear entry habit. The entry habit tells your body, “Now I am doing clean work.”

A handwashing station should be near the entrance or just outside the clean work area. It may be a sink with running water, or a simple container with a tap, a basin, soap, and clean towels. Handwashing removes dirt and reduces microorganisms on the hands. Public health guidance emphasizes washing with soap and water as a basic way to remove germs from hands, especially before clean tasks (Centers for Disease Control and Prevention, 2024).

A beginner tissue culture handwashing station should include:

- clean water,
- soap,
- a nail brush used gently when hands are dirty,
- clean disposable paper towels or freshly washed cloth towels,
- a covered waste bin,
- possibly 70% alcohol hand rub after washing, if available and used safely.

Handwashing is not a substitute for sterile tools or aseptic technique. It is one layer of protection. If you wash your hands and then touch your phone, hair, face, door handle, or soil bag, your hands are no longer ready for clean work.

A useful entry routine is:

1. Remove field shoes or use clean indoor sandals.
2. Tie back long hair.
3. Remove bracelets, watches, and rings if possible.
4. Wash hands with soap and water.
5. Dry hands with a clean towel.
6. Put on a clean coat, apron, or freshly washed shirt.
7. Wipe the work surface before starting.

You are not trying to become a hospital surgeon. You are training yourself to be consistent.

## Clothing for clean work

For beginner tissue culture, clothing should be simple, washable, and reserved for clean work. A clean apron, lab coat, or long-sleeved shirt is enough for many small setups. The goal is to reduce dust, plant hairs, soil particles, and skin flakes falling into the work area.

Useful clothing habits include:

- wearing clean clothes only for culture work,
- keeping hair covered or tied back,
- avoiding woolly or dusty fabrics,
- using closed shoes or clean sandals,
- wearing gloves when handling chemicals or sterile materials,
- changing gloves if they touch unclean surfaces.

Gloves can help, but they can also give false confidence. A gloved hand that touches a dirty bottle, phone, or face becomes contaminated just like bare skin. If gloves are used during transfers, they should be wiped with 70% alcohol before clean handling, and they should be changed when dirty or torn.

## The cleaning and washing zone

The cleaning and washing zone is where dirty containers, tools, and non-sterile materials are washed before sterilization. This area should be physically separate from the aseptic transfer zone.

In this zone you may wash:

- glass jars,
- plastic lids,
- forceps and scalpels before sterilization,
- measuring cylinders,
- media bottles,
- trays,
- used culture vessels after safe disposal of contaminated contents.

A good washing zone needs:

- water,
- detergent,
- brushes,
- drying rack,
- clean towels,
- a place for dirty items,
- a place for washed items,
- a container for waste.

Do not let dirty items and clean items mix. Use two trays if possible: one marked dirty and one marked washed. This simple separation prevents many mistakes.

For example, if you wash culture jars and place them back into the same muddy basin they came from, you have undone the washing. If you wash them and place them upside down on a clean drying rack, they are ready for sterilization.

## The media preparation zone

The medium is the prepared food and support material used to grow the culture. You learned in earlier chapters that it may contain water, sugar, mineral nutrients, vitamins, gelling agent, and sometimes plant growth regulators. Detailed recipes will come later. For now, we are planning the space where media can be measured, mixed, heated, poured, labeled, and prepared for sterilization.

A media preparation zone should have:

- a stable table or bench,
- access to clean water,
- measuring tools,
- containers for mixing,
- a heat source if medium must be dissolved,
- labels and marker pens,
- a balance if available,
- storage for ingredients,
- good lighting.

This area must be organized because media preparation involves measurement. A small error may matter. For example, confusing grams and milligrams can produce a medium that is too weak, too strong, or toxic to the plant. Plant growth regulators are often used at low concentrations, so careful weighing and dilution are important in tissue culture work (George et al., 2008; Smith, 2013).

A beginner should keep a dedicated media notebook or printed recipe sheet in this area. Do not rely on memory. If you prepare banana multiplication medium today and mint rooting medium tomorrow, the jars may look similar. Only labels and records prevent confusion.

## The sterilization zone

The sterilization zone is where media, vessels, and tools are treated to kill microorganisms. Professional laboratories often use an autoclave, which is a machine that sterilizes with pressurized steam. A farm-scale beginner may use a pressure cooker for some sterilization tasks, if it can reach suitable pressure and is used safely.

Pressurized steam sterilization is widely used in plant tissue culture because moist heat can sterilize many media and instruments effectively when the correct time, pressure, and loading conditions are used (George et al., 2008; Smith, 2013). However, a pressure cooker is still a pressure vessel. It must be handled with respect.

A sterilization zone should include:

- a strong, heat-safe table or surface,
- the pressure cooker or autoclave,
- heat-resistant gloves or cloths,
- a timer,
- water for the cooker,
- a cooling area,
- a safe path where hot vessels will not be knocked over,
- good ventilation.

Important safety habits:

- Read and follow the pressure cooker manufacturer’s instructions.
- Never open a pressure cooker under pressure.
- Do not block the steam vent.
- Do not overfill.
- Check gaskets and valves.
- Keep children away during operation.
- Let hot media cool before moving too much.

A beginner should not place the pressure cooker directly in the aseptic transfer area. Sterilization produces heat and steam, and the outside of the cooker is not sterile after handling. Sterilize first, cool safely, then move closed sterile containers to the clean transfer area.

## The aseptic transfer zone

The aseptic transfer zone is the cleanest working area in the small laboratory. This is where sterile vessels are opened, explants are placed onto media, and cultures are transferred from one container to another.

In a professional laboratory, transfers are often done in a laminar flow cabinet. This cabinet pushes filtered air in a smooth direction across the work surface. The air passes through a high-efficiency filter, reducing airborne particles and microorganisms. Laminar flow cabinets are standard equipment in many plant tissue culture laboratories because they support aseptic manipulation of cultures (George et al., 2008; Smith, 2013).

However, a laminar flow cabinet may be too expensive for a beginner farmer. There are lower-cost alternatives, but they must be understood honestly.

## Option 1: A proper laminar flow cabinet

This is the best option if the budget allows. It provides filtered airflow and a clean work surface. It still requires cleaning, correct use, and maintenance. It does not protect cultures if the worker reaches over open jars with dirty sleeves or places contaminated material in the airflow.

A laminar flow cabinet is suitable for:

- repeated commercial production,
- difficult crops,
- high-value cultures,
- work requiring lower contamination rates,
- training several workers.

If buying one, check filter quality, service availability, power needs, and whether it is horizontal or vertical flow. Also learn how to clean and operate it correctly.

## Option 2: A still-air box

A still-air box is a clear enclosed box with arm holes. It does not sterilize air. Instead, it reduces air movement. Less moving air means fewer dust particles are blown into open jars.

A still-air box may be made from a clear plastic storage box turned on its side or upside down, with two smooth arm holes cut into it. The inside can be cleaned before use. Tools and closed jars can be placed inside before work begins.

A still-air box is suitable for:

- learning basic transfers,
- low-cost experiments,

- small numbers of cultures,
- crops that are not extremely contamination-prone.

Its limitations are important:

- It does not filter air.
- It can become contaminated inside if not cleaned.
- Arm movement can stir air.
- It is awkward for large batches.
- It does not replace careful surface sterilization.

For a beginner with no laminar flow cabinet, a well-cleaned still-air box may be better than working on an open table in a dusty room. But it should be used with realistic expectations.

### Option 3: A clean enclosed work corner

Some beginners create a small clean transfer corner using plastic curtains, smooth walls, a cleaned table, and strict no-dust rules. This is less controlled than a still-air box or laminar flow cabinet. It may work for practice, but contamination rates may be high.

If using this method:

- choose a time of day with little air movement,
- close windows and doors before work,
- clean the table and surrounding surfaces,
- allow dust to settle before opening cultures,
- keep movements slow,
- work with only a few vessels at a time.

This can teach discipline, but it should not be mistaken for a professional clean bench.

## Designing the transfer table

Whether you use a laminar flow cabinet, still-air box, or clean table, the transfer surface must be simple. Do not crowd it.

A good transfer setup includes only what is needed:

- sterile culture vessels,

- sterilized tools,
- explants ready for transfer,
- sterile water or rinse containers if required,
- alcohol container if used safely,
- waste container,
- labels,
- marker,
- flame source only if appropriate and safe,
- notebook or batch sheet nearby but not in the wet work area.

Avoid placing these in the transfer zone:

- soil,
- mother plant pots,
- food,
- drinks,
- mobile phones,
- unnecessary books,
- open chemical bottles,
- fans,
- dusty cardboard boxes.

A crowded table causes mistakes. For example, if a sterile scalpel is placed beside unsterile leaf pieces, it may touch them before use. If labels are not ready, the worker may open several jars and then forget which is which. If waste is not organized, contaminated tissue may be set down near clean cultures.

Good aseptic work is calm and boring. That is a compliment.

## Air movement: friend outside, enemy inside

Farmers know that air movement can be useful. Wind dries leaves after rain, cools workers, and ventilates greenhouses. In tissue culture transfer work, however, uncontrolled air movement can be a problem because it carries dust and microorganisms.

During aseptic transfers:

- switch off fans,

- avoid open windows,
- avoid people walking past,
- avoid sweeping just before work,
- avoid talking directly over open cultures,
- avoid rapid hand movements.

If the room is hot, cool it before transfer work rather than running a fan during transfer. If you must use ventilation, use it before and after the aseptic work, not while jars are open.

This is one reason tissue culture work rewards planning. Prepare the room, let dust settle, then begin.

## The culture growth zone

After transfer, cultures need a safe place to grow. This is the culture growth zone or incubation area. It may be a shelf, rack, cabinet, or small room where closed culture vessels sit under controlled light and temperature.

The growth zone should be cleaner than ordinary storage, but it is not the same as the aseptic transfer zone because vessels remain closed. Its main job is to provide stable conditions and easy observation.

A good culture shelf has:

- smooth, washable shelves,
- enough space between vessels for air circulation,
- labels facing outward,
- protection from direct sun,
- steady artificial light if needed,
- limited dust,
- limited vibration,
- no insects,
- no storage of chemicals above cultures,
- a way to separate clean batches from suspicious batches.

Do not stack culture jars so tightly that you cannot see them. Do not place them near a hot roof, a cooking area, or a window with strong afternoon sun. Direct sunlight can overheat vessels and create uneven growth conditions.

## Light for cultures

Plants use light for photosynthesis, but tissue culture plantlets also receive sugar from the medium. This means their light needs can differ from plants in the field. Many shoot cultures are grown under relatively low to moderate artificial light, often with a daily light and dark cycle, but requirements vary by species and stage of culture (George et al., 2008; Bhojwani and Dantu, 2013).

For beginners, the practical goal is not to imitate full sunlight. It is to provide gentle, consistent light.

Common low-cost lighting choices include:

- LED tube lights,
- LED strip lights,
- fluorescent tubes where still available,
- small grow lights.

LED lights are often useful because they produce less heat than many older lamps and use electricity efficiently. The exact lamp choice depends on local availability, cost, and safety.

A common beginner schedule is 16 hours of light and 8 hours of dark for many shoot cultures, but this is not universal. Some cultures root better under lower light, some species need darkness for certain stages, and some protocols use different day lengths. Always follow the crop protocol when one is available.

A simple way to manage light is to use an electrical timer. This avoids forgetting to switch lights on or off.

Example:

A farmer places mint node cultures on a shelf with LED tubes above them. The timer switches lights on at 6:00 in the morning and off at 10:00 at night. The jars are not in direct sunlight. Each week the farmer checks whether shoots are green and upright, or pale and stretched. If shoots stretch strongly toward one side, the light may be too weak or uneven.

## Temperature control

Temperature affects plant growth, microbial growth, and the physical condition of the medium. Many plant tissue culture rooms use temperatures around the mid-20s degrees Celsius for a wide range of crops, but the correct temperature depends on species, genotype, and culture stage (George et al., 2008).

A beginner does not need perfect climate control at first, but large temperature swings are harmful. Very hot shelves can stress plantlets, increase condensation, dry medium edges, or encourage abnormal growth. Very cold conditions can slow growth or stop response.

Practical temperature steps include:

- Place the culture shelf away from direct sun.
- Avoid metal roofing heat if possible.
- Use a thermometer on the shelf, not only on the wall.
- Check temperature at the hottest time of day.
- Use shade, insulation, or ventilation outside transfer times.
- Keep lights far enough above vessels to avoid heating them.
- Avoid placing shelves near ovens, stoves, refrigerators, or engines.

If the room regularly becomes very hot, choose crops and protocols that tolerate local conditions, or consider low-cost cooling methods such as shading the roof, improving insulation, using reflective material outside the room, or working in the coolest season. Do not aim for large commercial production until temperature is stable enough to give repeatable results.

## Humidity and condensation

Humidity means the amount of water vapor in the air. Inside a culture vessel, humidity is usually very high because the vessel is closed and the medium contains water. On the culture shelf, room humidity also matters because it can encourage mold on surfaces if the room is damp.

Condensation is water collecting as droplets on the inside of the vessel, usually when warm moist air meets a cooler surface. Some condensation is common. Heavy condensation can make observation difficult and may cause water to drip onto cultures.

To reduce excessive condensation:

- avoid large temperature changes between day and night,
- let hot media cool before moving to a cooler shelf,
- do not place jars directly under cold drafts,
- keep lights from heating jars too strongly,
- use consistent room conditions.

Condensation itself is not always contamination. A clean jar may have droplets. But if droplets are cloudy, colored, slimy, or associated with spreading growth, contamination may be present. Chapter 20 will teach diagnosis in more detail.

## Storage: a quiet skill that prevents failure

Storage may sound boring, but poor storage ruins tissue culture work. Ingredients get mixed. Labels fade. Clean jars become dusty. Chemicals expire. Records disappear.

A small culture space needs storage for:

- clean empty vessels,
- sterile prepared media,
- media ingredients,
- plant growth regulators,
- tools,
- labels,
- personal protective equipment,
- cleaning supplies,
- waste containers,
- records.

Use closed cabinets, plastic boxes with lids, or shelves with curtains. Keep items grouped and labeled.

A simple storage rule is:

Clean with clean, chemicals with chemicals, records with records, waste with waste.

Do not store bleach above notebooks. Do not store sugar beside insecticide. Do not store sterile jars uncovered on a dusty shelf. Do not store plant growth regulators in drink bottles. Chemical containers should be clearly labeled and kept away from children, food, animals, and direct sun. Safety data sheets or supplier instructions should be kept when available.

Some tissue culture chemicals require cool or dark storage. Later chapters will discuss specific materials. For now, understand the principle: a chemical is not only “owned”; it must be managed.

## Labeling supplies

Labels are part of the culture space, not an afterthought. Every culture vessel should carry enough information to identify it even if the notebook is not open.

A basic jar label may include:

- crop name,
- variety or mother plant code,
- explant type,
- medium code,
- date of culture,
- batch number,
- worker initials.

Example:

BAN-A3 | shoot tip | M1 | 12 Mar | B24-03 | RK

This might mean banana mother plant A3, shoot tip explant, multiplication medium 1, prepared on 12 March, batch 24-03, worker RK.

Use labels that survive humidity and handling. Pencil on certain tapes may last better than weak ink. Some marker inks fade or dissolve when exposed to alcohol or moisture. Test your labels before trusting them.

A culture without a label is almost useless for production. You may enjoy seeing it grow, but you cannot responsibly sell or multiply it if you do not know what it is.

## The record area

The record area is where you keep notebooks, batch sheets, calendars, and observation forms. It should be near enough to use easily, but not in the wettest or cleanest part of the transfer area.

Records are not only for large laboratories. They are farmer tools. A farmer already keeps track of seed dates, fertilizer applications, rainfall, pest problems, and harvests. Tissue culture records are the same idea at a smaller scale.

At minimum, record:

- date,
- crop and variety,

- mother plant source,
- explant type,
- sterilization treatment,
- medium used,
- number of vessels started,
- number contaminated,
- number surviving,
- number producing shoots,
- date of subculture,
- observations.

Example record:

| Date | Crop | Explant | Medium | Started | Clean after 14 days | Shoots formed | Notes |
|---|---|---|---|---|---|---|---|
| 5 May | Mint | node | MS basic + cytokinin code C1 | 30 | 24 | 20 | 6 fungal, shoots green |

From this, the farmer can calculate that 24 out of 30 cultures remained clean after 14 days. That is 80%. If the next batch gives only 40%, something changed. Records help you ask what changed: mother plant cleanliness, sterilization time, worker technique, water quality, or room conditions.

Chapter 21 will teach production math in detail. For now, build the habit.

## Waste area and contaminated cultures

A culture space must include a plan for waste. Contaminated cultures should not be opened casually. A jar with fungal growth or bacterial slime can release spores or droplets if opened, spreading contamination to the room.

Contaminated vessels should be:

- marked clearly,
- removed from the culture shelf,
- kept closed until treatment,
- sterilized or disinfected before disposal or washing,
- recorded as contaminated.

Do not hide failures. Contamination records are valuable. If 3 jars out of 50 contaminate, that is very different from 35 jars out of 50. The first may be normal beginner loss. The second means the system needs correction.

Waste categories may include:

- plant waste,
- used medium,
- broken glass,
- chemical waste,
- used gloves or wipes,
- contaminated cultures.

Broken glass should go into a puncture-resistant container. Chemical waste should follow local safety rules and label instructions. Bleach and alcohol should never be treated casually; both require safe handling, and alcohol is flammable.

## Insect and pest control

Insects are serious enemies in a culture room. Ants, flies, cockroaches, mites, and small beetles can carry microorganisms and disturb cultures. Rodents can damage wiring, chew boxes, and contaminate surfaces.

Prevention is better than spraying.

Good pest prevention includes:

- sealing gaps around doors and windows,
- using window screens,
- keeping food out of the culture room,
- cleaning spills immediately,
- removing waste daily,
- keeping the outside area tidy,
- using door sweeps if needed,
- checking shelves regularly.

Avoid spraying insecticides inside the culture space unless there is no alternative and you understand the safety and contamination risks. Chemical residues can affect workers and possibly cultures. If pest control is needed, remove cultures and materials as appropriate, follow product labels, and allow the room to air safely before work resumes.

## Water supply and water quality

Water is used for washing, media preparation, rinsing, and cleaning. The water used in culture media should be as clean and consistent as possible. Professional laboratories often use distilled, deionized, or otherwise purified water for media preparation because mineral content and contaminants in water can affect culture response (George et al., 2008; Smith, 2013).

A beginner may have several options:

- distilled water bought locally,
- rainwater that has been properly collected and treated, where appropriate,
- filtered water,
- boiled and cooled water for some cleaning uses,
- laboratory-grade purified water if available.

For actual media preparation, use the best water you can reasonably obtain. Tap water may work in some places and fail in others because salts, chlorine, metals, or microbial load differ. If results are poor and unexplained, water quality is one factor to investigate.

Do not use pond water, irrigation canal water, or dirty storage tank water for media preparation.

## Electricity and safety

A small culture space may use lights, timers, a pressure cooker or electric sterilizer, a balance, a magnetic stirrer, a fan used outside transfer time, or a small air conditioner. Electricity must be planned safely.

Basic electrical safety includes:

- keeping cords away from water,
- avoiding overloaded sockets,
- using grounded equipment where required,
- keeping plugs off wet floors,
- using proper extension cords,
- protecting wires from rodents,
- switching off equipment after use,
- keeping flammable alcohol away from sparks and flames.

If the power supply is unreliable, plan for it. A short power cut may not harm closed cultures, but repeated heat buildup from failed ventilation or lights switching unpredictably can affect growth. A simple timer with battery backup, backup lighting, or choosing culture schedules around reliable power hours may help.

## Low-cost equipment alternatives

A beginner farmer does not need to buy every professional item immediately. It is better to start with a small, reliable setup and improve it as skills grow.

Here are common professional items and practical beginner alternatives:

| Professional item | Purpose | Low-cost alternative | Important caution |
|---|---|---|---|
| Autoclave | Sterilizes media and tools with pressurized steam | Good pressure cooker | Must reach suitable pressure; follow safety instructions |
| Laminar flow cabinet | Provides filtered clean air for transfers | Still-air box for learning | Does not filter air; contamination may be higher |
| Culture room with controlled environment | Stable growth conditions | Clean shelf with LED lights and thermometer | Watch heat and insects |
| Laboratory glass culture vessels | Holds sterile medium and cultures | Reused glass jars with suitable lids | Must tolerate heat and seal properly |
| Laboratory bench | Smooth clean work surface | Smooth table covered with cleanable surface | Avoid wood cracks and rough surfaces |
| Distilled water system | Produces purified water | Purchased distilled water or reliable purified water | Test consistency if problems appear |
| Laboratory refrigerator | Stores some chemicals and stock solutions | Dedicated small refrigerator if needed | Do not mix with food; label clearly |

Low-cost does not mean careless. A cracked jar, unsafe pressure cooker, dirty still-air box, or unlabeled chemical is not economical. It is a future loss.

## A model small-room layout

Imagine a farmer has a small room about 2 meters by 3 meters. It has a door, one screened window, an electrical outlet, and a washable floor.

A practical layout might be:

- Near the door: handwashing container, soap, towel, waste bin.
- Left wall: washing and media preparation table.
- Back corner: pressure cooker on a heat-safe surface.

- Right wall: aseptic transfer table with still-air box.
- Far wall: culture shelf with LED lights and timer.
- Small cabinet: media ingredients, clean jars, tools, labels.
- Clipboard near shelf: daily observation sheet.

The workflow is arranged so that dirty plant material enters near the washing area, prepared sterile vessels move toward the transfer area, and finished cultures go onto the shelf. The culture shelf is not beside the washing basin, because splashes and dirty vessels belong away from growing cultures.

This small room is not perfect, but it is logical. Logic reduces contamination.

## A model one-table learning setup

Some learners do not yet have a full room. They may begin with one table in a clean room for practice. In that case, time separation becomes important.

For example:

1. In the morning, the table is used for media preparation.
2. After media is sterilized and moved away, the table is cleaned.
3. Later, only transfer materials are placed on the table.
4. The still-air box is cleaned and used for transfers.
5. Finished cultures are moved to a separate shelf.
6. Dirty items are removed immediately.

This is less ideal than separate zones, but it teaches the correct sequence. The main rule is never to mix dirty and clean work at the same time.

## Preparing the room before work

Before culture work, prepare the room slowly. Rushing creates contamination and injury.

A useful pre-work routine:

1. Remove unnecessary items from the room.
2. Sweep gently or mop; do not raise dust just before transfers.
3. Wipe work surfaces.
4. Check that labels, tools, and vessels are ready.
5. Check the culture shelf temperature.

6. Wash hands.
7. Put on clean clothing.
8. Clean the transfer area or still-air box.
9. Arrange materials in the order of use.
10. Begin only when everything is ready.

Many failures happen because the worker begins and then realizes something is missing. The jar is open, but the forceps are not ready. The explant is sterilized, but labels are missing. The medium is cooling, but the shelf is full. Preparation prevents panic.

## Daily and weekly routines

A culture space stays clean because of routine, not because of one big cleaning day.

Daily routines may include:

- checking temperature,
- checking lights and timer,
- looking for contaminated vessels,
- removing waste,
- wiping spills,
- making brief records,
- making sure doors and windows are closed or screened.

Weekly routines may include:

- deeper cleaning of shelves,
- checking stored ingredients,
- cleaning the still-air box,
- checking labels for fading,
- reviewing contamination records,
- inspecting for insects,
- organizing tools and supplies.

Monthly routines may include:

- checking pressure cooker seals and valves,
- reviewing stock levels,

- checking chemical storage,
- replacing worn brushes or towels,
- evaluating whether the layout is working.

A well-run small culture room should feel calm when you enter it. If every surface is full, labels are missing, and old cultures are mixed with new ones, the room is asking for failure.

## Common beginner layout mistakes

It is helpful to know the common mistakes before making them.

One mistake is placing the culture shelf near a window. The cultures may receive direct sun, overheat, and grow unevenly. Use artificial light if possible, and keep sunlight controlled.

Another mistake is using fans during transfers. Fans move dust. Cool the room before work, then turn the fan off during aseptic handling.

Another mistake is keeping mother plants inside the culture room. Mother plants carry soil, insects, spores, and field dust. Keep them in a separate stock plant area.

Another mistake is opening contaminated jars to “check the smell.” Do not do this in the culture room. Contaminated cultures should be treated carefully and kept closed until safe disposal.

Another mistake is buying hormones before buying labels and cleaning tools. Advanced chemicals cannot compensate for poor organization.

Another mistake is scaling too early. If you cannot keep 20 jars organized, 500 jars will not solve the problem. First prove that your space, routine, and records work at small scale.

## When to upgrade

A low-cost setup is a learning tool and possibly a small production tool. As your work grows, you may need to upgrade.

Consider upgrading when:

- contamination remains high despite good technique,
- you are producing valuable crops,
- you need consistent batches for customers,
- the still-air box is too slow,

- temperature is too unstable,
- records show large unexplained losses,
- you are training other workers,
- you need to meet buyer or regulatory quality expectations.

Possible upgrades include:

- a proper laminar flow cabinet,
- a dedicated media preparation room,
- better purified water,
- a controlled incubation room,
- improved shelving,
- air conditioning,
- a dedicated refrigerator for chemicals,
- professional testing support for disease-free claims.

Upgrade in the order that solves real problems. If records show contamination during transfer, a better aseptic workstation may help. If records show cultures grow well in cool months and fail in hot months, temperature control may matter more. If labels are failing, better labeling may be the cheapest upgrade with the biggest effect.

## A practical starting plan

For a beginner farmer, a sensible starting plan is:

1. Choose one small room or clean enclosed area.
2. Remove soil, food, animals, and unnecessary storage.
3. Create a handwashing point.
4. Set up one washing/media table.
5. Set up one sterilization point.
6. Set up one transfer area, preferably with a still-air box or laminar flow cabinet.
7. Set up one culture shelf with gentle light and a thermometer.
8. Create storage boxes for clean vessels, tools, labels, and ingredients.
9. Start a record notebook before starting cultures.
10. Practice with a small number of jars before expanding.

The first goal is not maximum production. The first goal is learning whether your space can support clean, repeatable work.

## The farmer’s mindset for a clean culture space

A good culture space is not only a physical arrangement. It is a mindset.

In ordinary farm work, speed is often valuable. In tissue culture, speed without control causes losses. The best worker is not the fastest person in the room. The best worker is the person who prepares well, moves calmly, notices details, labels everything, and stops when conditions are wrong.

If dust is blowing through the window, wait. If the pressure cooker is not working correctly, stop. If labels are missing, prepare them first. If you are tired and rushing, do fewer cultures. If contamination appears, record it and learn.

T

# Document information

## Chapter 3: Setting Up a Small Low-Cost Culture Space

| | |
|---|---|
| **Project** | Plant Tissue Culture for Farmers |
| **Document** | Document 1.7 |
| **Author** | hendri |
| **Verifier** | Not verified |
| **Downloaded** | July 05, 2026 22:56 KST |
| **Status** | Working |
| **Document link** | https://www.theorytrace.com/projects/plant-tissue-culture-for-farmers/documents/chapter-3-setting-up-a-small-low-cost-culture-space/ |