

Perennials Propagation From Cuttings & Tissue Culture

TC challenges

- ⤴ Expensive propagules
- ⤴ Long lead times for plantlets – 9-12 months or more
 - This is improving from some suppliers, more regular availability
- ⤴ Often limited availability without preordering
- ⤴ Often poor communication with supplier, with surprises when shipments arrive
 - True even for European labs!
 - “Creative substitution” to make numbers is not uncommon
- ⤴ Off-type plants can be a significant problem

Perennial Cutting Suppliers

There are good options for purchasing perennial URCs from domestic and offshore suppliers, though there have been some recent changes to the market. The following are the suppliers Raker primarily relies on for perennial cuttings:

Agribio (Ecke/Fides/Oro) – Guatemala	FloraPlant/HMA – Mexico
Aris/GreenLeaf – Columbia	GroLink – Brazil
Ball – Costa Rica (at Florexpo)	Jaldety – Israel
Cohen – Israel	North Carolina Farms – NC
Florensis – Europe	PSI – Mexico
Florexpo – Costa Rica	Syngenta Hort – Guatemala, Kenya
Hishtil – Israel	

TC Suppliers

Located all over the world – domestic, Asian, European, Australia, New Zealand

Order fulfillment generally poor to OK, regardless of country of origin. Improving somewhat. Thai Orchid Lab has been the most consistently good supplier Raker has used.

Evaluating suppliers

Suppliers vary in:

- ⤴ Cleanliness protocols
 - Number of viruses screened for
 - Frequency of testing
- ⤴ Performance of URCs / plantlets
- ⤴ URC / plantlet vigor
- ⤴ Loss %

- ⤴ Off type % for TC plantlets
- ⤴ Minimum order size
- ⤴ Minimum per variety
- ⤴ Overpack % (if any)
- ⤴ Availability windows and volume
- ⤴ Online availability and ordering capabilities

Cutting specs

- ⤴ “European” style cutting tends to be small
- ⤴ Smaller URCs can be excellent for high density trays
- ⤴ Understand specs by supplier to purchase the size(s) you prefer
- ⤴ Some suppliers can cut to your specs

TC Plantlets

- ⤴ Wide range of containers and packaging methods used
- ⤴ Plantlets may be in agar or removed from agar and washed (ex agar) before shipping
- ⤴ Ex agar plantlets can be easier to handle
- ⤴ Important to wash off agar before planting for in agar material
- ⤴ Bagged, washed plantlets are another option some suppliers are using
- ⤴ Consistent arrangement in containers helps with sticking efficiency
- ⤴ Plantlet size can vary by supplier
- ⤴ Uniformity within a container and across a shipment can vary

Receiving

In a typical busy stick week, Raker receives URCs from 12-15+ suppliers, and may stick 1,000,000 or more cuttings. Whether for URCs or TC, a check-in process to verify everything ordered was shipped is critical.

- ⤴ Check box temperature
- ⤴ Confirm count and quality
 - ⤴ Report any concerns or claims to suppliers ASAP
- ⤴ Stage items in storage according to stick priority (see below) and rooting environment / speed
- ⤴ Generally not worth planting any TC plantlets that are breaking down
 - ⤴ Rotten fish smell often associated with breakdown
- ⤴ Ensure storage environment is optimal
 - ⤴ High humidity, 48-50° F (9-10° C)
 - ⤴ With light, if plantlets are to be stored over 24 hours

Priority stick items

Some URC items tolerate storage better than other items. Minimize storage time for items that do not tolerate storage well

<i>Achillea</i>	<i>Lithodora</i>
<i>Artemisia</i>	<i>Perovskia</i>
<i>Coreopsis</i>	<i>Phlox subulata</i>
<i>Gaillardia</i>	<i>Sedum</i>
<i>Geranium spp.</i>	<i>Viola</i>
<i>Hedera</i>	

Sanitation

- ⤴ Critical to minimize disease problems

- ⤴ Prop house should not be open to casual traffic
- ⤴ Hand sanitization and foot bath to reduce pathogen entry
- ⤴ Sterilize benches and floor regularly
- ⤴ Powdered milk denatures TMV, can be added to sanitation plan if TMV has been problematic
- ⤴ Additional measures for workers who smoke
 - Gloves and smock
 - Consider only non-smokers for propagation area work

Moisture

A critical factor for rooting success. Need sufficient humidity and moisture to promote fast rooting, but too much overhead moisture can promote disease and slow rooting. Humidification can reduce need to apply water to foliage.

Misting is important to keep foliage turgid and promote rooting. Reduce mist as cuttings root, and increase moisture fluctuation. Misting cycles will need to be modified based on plant species and rooting speed as well as environmental conditions including relative humidity, light intensity, and temperature. Lower humidity, higher light intensity, and warmer temperatures generally require increased misting.

Water quality

We use with sulfuric and phosphoric acid to control pH & alkalinity

- ⤴ pH ~ 6.0
- ⤴ alkalinity ~ 60-70 ppm
- ⤴ phosphorous ~ 5-10 ppm

Temperature

Provide the proper rooting environment for the proper length of time

- ⤴ General 72-78° F (22-25.5° C) a good general temperature
- ⤴ Crops which dislike heat may prefer 65-72° F (18-22° C)

Higher temperatures speed drying of trays – ensure proper moisture levels are provided

Shade can help reduce temperature and control moisture loss

Hormone application

Raker uses water-soluble IBA for hormone application

Raker standard IBA rates range from 250 to 5,000 ppm

- ⤴ 250 ppm used on some sensitive crops
- ⤴ 4,000 ppm is rate on most crops
- ⤴ Some slow rooters get 5,000 ppm

A post stick IBA spray is 1/3 tsp/gallon (~ 60 ppm) used about a week after sticking can stimulate slow-rooting items (or a sub-par performing shipment of cuttings)

Prestige fungicide can also speed rooting

- ⤴ Trials ongoing

TC Propagation Environment

Plantlets need very high RH after sticking

- ⤴ Have not developed cuticle on leaves to reduce moisture loss
- ⤴ First week after sticking is critical for optimal environment
- ⤴ Many growers use hoops with plastic and/or Remay fabric for establishing TC
- ⤴ Gradually reduce RH during the first week, as plants acclimate to the real world environment

Fertility

Extra feed crops get a light feed (50 ppm N) 10-14 days after sticking, as soon as they have rooted. They also receive 150-200 ppm N fertilization with every irrigation after the first feeding.

Rooting Environments

We use timers and vapor pressure deficit (VPD) sensors to set up rooting zones

Use higher mist frequency after sticking until initial callous forms

- ⤴ 5-10 seconds mist every 5-10 minutes
- ⤴ Reduce mist as rooting continues

Raker classifies rooting environment by rooting speed

- ⤴ Fast – generally in propagation 3-4 days
- ⤴ Average – generally in propagation 5-7 days
- ⤴ Slow – generally in propagation 7-10 days
- ⤴ Very Slow – generally in propagation 10+ days
- ⤴ See handouts for details by species

Lower mist application is beneficial for grey foliage items

Can use fog to increase humidity and reduce overhead misting

Sticking accuracy

Speed of sticking URCs of TC plantlets is just one factor

- ⤴ Material must be handled carefully to prevent damage
- ⤴ Material must be stuck properly
- ⤴ Correct depth
- ⤴ Correct # URCs per cell
- ⤴ No skips in tray

Moisture

A critical factor

Goal: provide enough water to allow rooting without over saturating media or keeping foliage overly wet

Can use fog to humidify and reduce need for overhead mist

Temperature

Provide the proper rooting environment for the proper length of time

Higher temperatures speed drying of trays – ensure proper moisture levels are provided

Shade can help reduce temperature and control moisture loss

Nutrition

Media with starter charge reduces need for early feed

Consider nutrients in irrigation water

- ⤴ P, S from acid injection
- ⤴ Mg, Ca in well water

Know the expected EC of your fertilizer solution, and check it before feeding!

Pest management

An IPM program is essential

- ⤴ Integrated Pest Management is not looking at the bugs on the cards every week, then spraying!
- ⤴ Don't rely on just chemicals for control, or you will see resistance eventually
- ⤴ Sanitation and weed control are critical

The Raker System

Efficiency

Raker has made significant efforts to improve efficiency and reduce waste

- ⤴ Lean manufacturing reviews have been an important part of this process
- ⤴ The Lean review process has led to major gains, in large part through simple changes and better organization of the work process
- ⤴ Job tracking boards help employees see how much work has been done and how much remains
- ⤴ Collecting data on sticking speed by crop helps improve future labor need forecasting

Sticking lines

Given the volume of URCs to stick in a busy week, efficiency is important

- ⤴ Sticking line designed for efficiency
- ⤴ Up to 14 people, 2 lines
- ⤴ Conveyors to bring empty trays and remove finished trays

Trays are randomly checked after sticking, once placed on benches

- ⤴ Evaluated for quality
- ⤴ No skips
- ⤴ Proper depth
- ⤴ Correct # per cell

Attention to Detail (ATD) is key

Pay attention to all the little things – they add up to big problems if you don't

Consistency in:

- ⤴ Media
- ⤴ Tray filling
- ⤴ Covering
- ⤴ Watering
- ⤴ Consistently provide the correct environment for the crop, at the right time

Media and tray filling

Our media:

- ⤴ 70% sphagnum peat
- ⤴ 23% perlite
- ⤴ 7% calcine clay
- ⤴ Custom nutrient blend

Any media can work if...

- ⤴ It is consistent
- ⤴ pH is 5.5-6.0
- ⤴ Trays are filled consistently

Tray filling key factors:

- ⤴ Media well mixed
- ⤴ Media consistent from bag to bag
- ⤴ Media at proper moisture
- ⤴ Filling equipment set up properly

Ellepots

- ⤴ Use very similar media to our plug trays, but with coarser grade of perlite for better aeration
- ⤴ Made on-site

Liner nutrition

First feed as soon as root initials are present

- ⤴ Generally use 14-4-14 at 125 ppm for first feed
- ⤴ Later feeds with 18-3-18 at 125-150 ppm
- ⤴ Liners generally fed every other day, due to relatively short crop time
- ⤴ 20-10-20 can be used to push growth if necessary

TC tray nutrition

- ⤴ Generally receive a foliar feed at 50-75 ppm 14-4-14 within the first week of sticking
- ⤴ Treated as liners once established

Extra feed crops

Heavy feeders generally are fed more frequently, vs. at a higher rate. Vegetative liners in this category are constant fed, seed plugs are generally fed 3-4x per week.

Buddleia	Geranium spp.	Phlox paniculata
Campanula	Heuchera	Rosmarinus
Coreopsis	Iberis	Salvia
Gaillardia	Oenothera	

Growth Regulators

- ⤴ Spray applications
 - B-Nine (2,500-5,000 ppm)
 - Sumagic (10 to 15 ppm)
- ⤴ “Sprench” applications
 - Bonzi (5 ppm)
 - A-Rest (10 ppm)
- ⤴ Tank mixes

Pest Management – Disease

Grow dry!

Widespread fungicide drenches not generally recommended

- ⤴ Spot spray problem crops
- ⤴ Preventative drench OK if you expect problems in a specific crop
- ⤴ Identify the disease, and use an effective chemical control
- ⤴

Sanitation

- ⤴ GreenShield is our primary sanitizer in propagation
- ⤴ We power wash and sanitize the mist house 2-3x per week
- ⤴ Drain gutters in floor are cleaned and sanitized weekly

Fungicides

TC material is treated with Phyton 27 at lowest label rate within the first 5 days of sticking

- ⤴ Helps plantlets recover from stress and damage during planting

Liners generally receive a RootShield application once roots have developed

- ⤴ Helps reduce disease pressure, especially in high density liner trays

Pest management – Weeds

Weeds can be a source of virus disease, so control is essential

- ⤴ Propane flamer provides excellent weed control
- ⤴ Be careful using around greenhouse coverings and flammable material!

Hormone

We use water soluble IBA at several rates

- ⤴ 5,000 – some slow rooters
- ⤴ 4,000 ppm – most perennials receiving hormone
- ⤴ 250 ppm – some sensitive crops
- ⤴ Applied as a spray or dip before sticking

Improving success

- ⤴ Attention to Detail (ATD) is key – pay consistent attention to the little things
- ⤴ Surfactants – reduce moisture loss from leaves, can use within 1st week of sticking, particularly if URCs are large or if URCs start to flag / wilt after sticking
- ⤴ Post-stick low-rate IBA spray (60 ppm) for slow rooters – can improve rooting success for items that are rooting slowly. Apply 1-2x after the first week in propagation
- ⤴ Prestige fungicide improves rooting in URCs, may have similar effect on TC plantlets
 - Worth trialing
- ⤴ During production under short days and low light, we use HPS lighting – 16 hour days (day extension), including lighting on cloudy days. Light is at 300-400 footcandle intensity. Note that new reflector designs can significantly increase light output, with 600 watt bulbs producing as much light as 1,000 watt bulbs with older reflectors!

Diagnosing problems

- ⤴ Check crop history
 - ⤴ Determine if anything obvious was done wrong
- ⤴ Check growing medium pH
- ⤴ Check irrigation water pH, alkalinity
 - ⤴ Review water sampling results
 - ⤴ Verify injectors are working properly
- ⤴ Verify propagation environment
 - ⤴ Check with greenhouse management software logs, if available
- ⤴ Consider starter material issue
 - ⤴ Do not simply assume it was “the supplier”
 - ⤴ Verify quality of plantlets or cuttings from check-in information
 - ⤴ Verify timely sticking of cuttings or plantlets