

Managing The Cuttings' Environment

In the second article of a 2-part series on cuttings, researchers at North Carolina State, Clemson and Michigan State Universities provide insight on managing temperature and light and preventing diseases during propagation.

By Roland Leatherwood, Roberto Lopez and Amy Enfield

In the second article of our 2-part series, we are presenting research-based information from North Carolina State, Clemson and Michigan State Universities on how to properly manage two of the most critical components of the propagation environment: temperature and light. We will also discuss how to prevent pathogens and disease from devastating your cuttings during propagation.

Managing Temperature

Temperature has to be carefully balanced against cutting stress. Growers should maintain air temperatures high enough to encourage rooting but not so high that leaves become stressed. Bottom heat is very effective in hastening rooting, and systems employ either electrical heating cables or tempered water. Media is usually kept at 72-77° F while air temperature is maintained at 68-73° F. If bottom heat is not used, air temperature should be maintained between 77 and 80° F. Maintaining air temperatures lower than medium temperatures retards shoot growth while promoting root development.

Excessive heat can damage cuttings. Consequently, during the summer, it is usually a question of cooling the propagation area ▶



Large-scale cutting propagation. (Photos: Roland Leatherwood)

Points To Remember

- Prepare for the arrival of your cuttings by cleaning equipment and lining up resources.
- Check your cuttings on arrival, and remember it may not pay to stick damaged shipments.
- Store cuttings at 80- to 95-percent humidity at the lowest temperature possible for each species, and make sure they are not wet.
- Media should be well drained and never soggy. Incorporate slow-release fertilizer or use fertigation to boost root development as needed.
- Provide 100-percent humidity and adequate moisture to cuttings to counteract wilting and slow transpiration.
- Start with high mist frequency (such as six seconds of mist every six minutes) and gradually reduce both duration and frequency as cuttings develop callus and roots.
- Cuttings need gradually increasing light intensities to develop roots quickly. If the daily light integral is minimal, cuttings will stretch and rooting will be delayed.
- Watch for precocious flowering; control photoperiod where needed.
- Warmth is important and bottom heat, in particular, will encourage rapid root formation.
- Pathogen control requires frequent monitoring, record keeping, sanitation and rotation of fungicide types.
- The transition from propagation area to greenhouse should be gradual, but some water stress will encourage root development.

crop cultivation

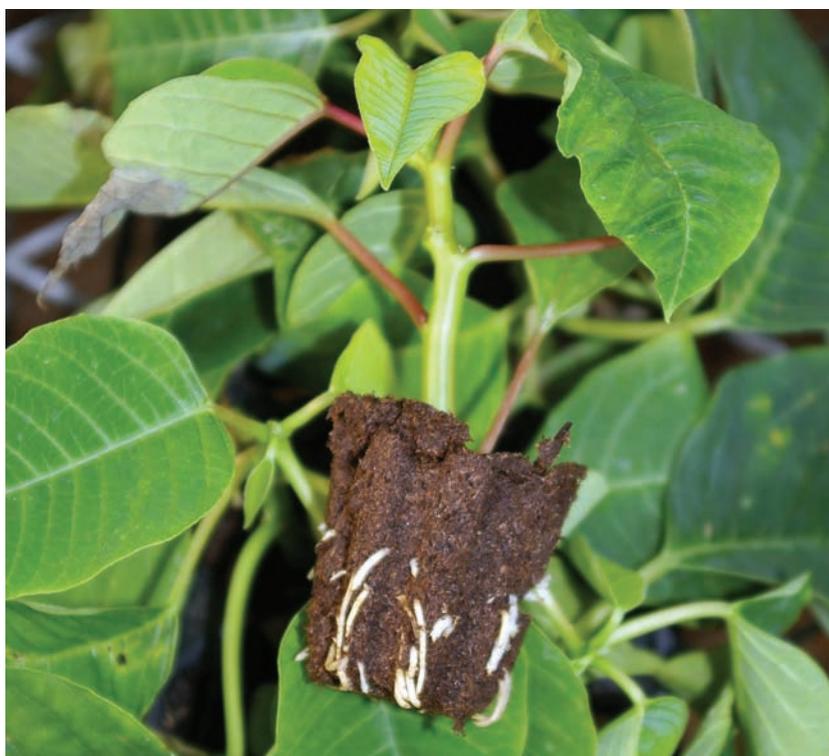
rather than heating. Both air and media temperatures should be monitored frequently; even in the summer, the media temperature can drop below set points from cold water and high rates of evaporation. Evaporative cooling using mist or fog is effective at lowering temperatures. Other cooling techniques limit the amount of sunlight entering the propagation space via shade cloths or hosing down the propagation space while running the exhaust fans. It is very important to remember that lowering your temperature set point in propagation will increase rooting time!

Managing Light

Photosynthesis, the process by which cuttings derive energy and food for rooting, is driven by light. Unrooted cuttings require indirect, diffused sunlight but never full sunlight. To initiate and develop roots, provide cuttings with sufficient light to support photosynthesis but not so much as to stress the cutting. Several methods are used to reduce the amount of light coming into the propagation space.

Shade cloth can be used to reduce light. It is available with high thread densities for light reduction or it can be used additively. Shade cloth is easily removed as needed and can be reused from year to year. Retractable shade curtains are an expensive option but provide excellent control

of light entering the greenhouse. They can be opened on cloudy days and closed when it is sunny so consistent light intensities can be maintained. Depending on installation,



Rooted poinsettia plug that is ready for planting.

ties. It can be sprayed through a pressurized system, and a few workers can cover a large area in a short amount of time. Whitewash will gradually wear off with rain, hail or snow or it can be removed by hand, but once applied, it will persist for several months.

Gradually Increasing Light

Light is similar to moisture in that it should vary throughout root initiation and development process. However, unlike moisture, light is minimized initially and then gradually increased as the cuttings develop roots. The process for most crops is typically described in three stages for high light crops. (There are typically five stages in propagation from unrooted cuttings, including stage 0, before cutting harvest or delivery, and stage 1, cutting arrival or harvest and sticking. The other stages are as described here.)

Stage 2 is from stick to callus formation. Light intensity should be maintained at 500-1,000 foot-candles. In stage 3, after root initiation, usually 5-12 days after stick, light should be increased to 1,000-2,000 foot-candles. At stage 4, forming the plug stage or toning the cutting, 10-15 days after stick, cuttings require 2,500-4,000 foot-candles. Increasing light intensity gradually provides more light to the cuttings as they develop roots and are able to tolerate it. It is also a good method for hardening off cuttings. ▶

retractable shade curtains also can save on heating costs and even be integrated into existing computer controls.

Whitewash can be used on the interior or exterior of greenhouses to reduce light intensi-

ties. It can be sprayed through a pressurized system, and a few workers can cover a large area in a short amount of time. Whitewash will gradually wear off with rain, hail or snow or it can be removed by hand, but once applied, it will persist for several months.

Benchmark® All-Plastic Displays

Built strong, built to last -- any size, any shape



Dump that block and board and step up to a clean, fresh, professional look that will last for years.

fixtures that fit your spacing needs

800-523-6899

www.structuralplastics.com

BENCHMARK
All Plastic Display Systems

Patent No. 5,579,702 & 5,683,004 © 2005

Plant Tissue Culture Laboratory Kits



Features:

- Compact
- Adaptable
- Cost efficient
- Field tested
- Field proven

Contains:

Laminar Flow hood, pressure sterilizer, balance, culture vessels, orchid media and formulae, instruments and cd technical training manual.

Phytcultures Ltd.

Visit our website at:
www.phytcultures.com

Tel: (902) 629-1229

Fax: (902) 629-4645

Hobby Kit Models & Commercial Models Available

Write in 733

Write in 781

Be part of our satisfied professional growers... Try our **BM MIXES!**

"We understand at Klepac Greenhouses that in order to produce a **high quality crop**, it is critical that we start off with a **consistent soil mix**. After over 50 years of mixing our own soil, we switched over to **Berger's Bag Mixes**. We still maintain the **quality** that our customers have come to expect from us, and we are also seeing a **cost savings**."

Jimmy Klepac, owner
Klepac Greenhouses, Inc.
Blanco (Texas)



Manufactured with care, the **BM series** of **Berger mixes** provides you with a multitude of variations to meet your specific requirements. Whether it be a **BM1 mix** offering a higher level of aggregates or a **BM8 mix** offering a controlled release fertilizer, **Berger** can provide you with the best quality that will meet your satisfaction.



The Root Environment Experts!

Write in 234

Berger Horticultural Products Inc., 121, R.R.1 • Saint-Modeste (Québec) • Canada • G0L 3W0
Phone: 1 800 463-5582 (U.S. only) • Fax: 1 (418) 867-3929 • e.mail: info@bergerweb.com • www.bergerweb.com
US Mixing plant: 8822 Texas Highway 19N • Sulphur Springs, TX • U.S.A 75482-1116

crop cultivation



These coleus cuttings are in propagation.

If cuttings are photoperiodic, day length during propagation must also be managed. Photoperiodic responses in plants require very low light intensities (roughly 10 foot-candles) and can be provided easily and inexpensively using incandescent lights. The generally recommended photoperiod during propagation of unrooted cuttings is 12-13 hours. This photoperiod is not so short that it causes cuttings to become dormant. It is also sufficiently long so flowering in most short-day plants is not induced and not too long to initiate flowering long-day plants. Petunias, for example, will flower during propagation under long days, so the photoperiod should be reduced to assure accurate crop timing. There are exceptions, however. A few species, such as plectranthus (short-day plant), require a 16-hour photoperiod to prevent flowering of cuttings.

Both light intensity and duration are efficiently described by the daily light integral (DLI), which is defined as the amount of light per square meter per day ($\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$). During propagation, a DLI below or above an optimum range reduces or inhibits rooting. If the DLI is too low, the cuttings are unable to intercept enough light for adequate photosynthesis, thus delaying rooting. If the DLI is too high, transpiration rates are increased and drought stress can inhibit rooting. Researchers at Michigan State University have shown that higher DLI ($\geq 3 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$) promotes more robust petunia and New Guinea impatiens cuttings with a greater root mass. Keep in mind that a particular DLI can be reached by increasing photoperiod or increasing light intensity.

Pathogens And Monitoring

Fungi and bacteria are plentiful in the greenhouse. Pythium, Penicillium, Rhizoctonia, Pestalotiopsis, Glomerella, Anthracnose and Botrytis are just a few organisms that cause havoc during propagation. Of these, Botrytis is usually the most common and destructive. Integrated pest management (IPM) has proven effective in dealing with these organisms. Preventive fungicide applications and regular rotation of chemicals can keep most diseases in check. Biocontrol agents such as the fungus *Gliocladium virens* are good preventative alternates to chemical control of *Rhizoctonia colani* and *Pythium ultimum*.

There are several other non-chemical disease control techniques. Frequent policing and removal of abscised or yellowing leaves, rouging of diseased or infested cuttings and stringent sanitation of propagation houses and work areas will go far in checking the outbreak of disease. It is also important to separate cuttings from different suppliers in case disease issues arise.

Mist and fog systems also play a role in preventing disease. The film of water on leaves can prevent fungal spores from colonizing plant tissues. However, water on foliage is typically necessary for Botrytis species to germinate and free water encourages bacterial spread, so clean cuttings, equipment and media are essential. Yet higher allowable irradiance under mist and fog permits cuttings to produce more energy for initiating roots and fighting off pathogens.

All of these techniques mentioned will help assure pathogen control and successful



Cleary Chemical Provides Solutions That Work

For nearly 70 years, Cleary Chemical has provided the green industry with cutting-edge plant protection technology and the expertise to solve pest and disease control problems in the greenhouse, nursery and landscape industries.

GROWERS HAVE COME TO RELY ON CLEARY FOR LEADERSHIP PRODUCTS LIKE:

TriStar® 70 WSP Insecticide

TriStar 70 WSP is the #1 foliar insecticide with broad spectrum control of key, economically important insect pests like aphids, mealy bugs, caterpillars, scales, whiteflies, thrips, leaf eating beetles and leaf miners. The new TriStar 30 SG formulation will make this leading insect control even easier to measure, mix and apply in small gallon sprayers (see below).



TriStar® 30 SG Insecticide – NOW AVAILABLE!

TriStar 30 SG Insecticide is a new, water-soluble granular formulation of the #1 foliar insecticide you've come to trust. TriStar 30 SG mixes easily and, like the original TriStar 70 WSP, is compatible with many tank mix partners. TriStar 30 SG comes packaged in eight ounce containers that allow for multiple measurements of product, which is particularly convenient for small volume users. TriStar 30 SG is effective against all of the same pests as TriStar 70 WSP including scale, aphids, thrips, and whiteflies.

3336® Fungicide

For years, growers have relied on 3336 for broad-spectrum control of troublesome diseases like Leaf Spots and Blights, Powdery Mildews, Rusts and Stem, Crown and Root Rots. 3336 can be applied as a foliar spray, dip or soil drench.

Spectro™ Fungicide

Spectro – the no-risk premix of 3336 and Daconil® – saves you the time, trouble and worry of tank mixing these two, top disease control products. Spectro also has a reduced REI of 12 hours.

Alude™ Systemic Fungicide

Alude fights plant diseases such as Fire Blight, Downy Mildew, Pythium, and Phytophthora related diseases. Rapid foliar uptake and complete systemic activity ensure preventative disease protection all the way down to the roots.

26/36 Fungicide™

26/36 is a new, premixed combination of two trusted turf and ornamental fungicides, iprodione and thiophanate methyl. The contact and systemic activity of 26/36 is effective against a broad spectrum of diseases while providing long lasting control.

For more Cleary products and expertise, contact your local supplier or visit our website at: www.clearychemical.com.

The Cleary logo, 3336 Plus, ClearTec, 26/36 Fungicide, 3336, Spectro, Protect and Alude are trademarks of Cleary Chemical Corporation. TriStar is a registered trademark of Nippon Soda Co. Ltd.



SPRAY THE WORD!

*NEW! TriStar 30 SG
for sprayers under
50 gallons.*



*TriStar 70 WSP for
50+ gallon sprayers.*



Cleary's TriStar 70 WSP and NEW 30 SG Insecticides now have all your spraying applications covered – big and small.

Great News! Cleary now has all your spraying needs covered. With NEW TriStar™ 30 SG, you get the leading insect control in a more effective and easy to measure formulation for smaller spraying applications. And like TriStar 70 WSP, you get the same fast contact and long residual control you've come to rely on. To find out all the benefits of TriStar 30 SG and 70 WSP Insecticides, call **1-800-524-1662** or visit **www.clearychemical.com**.



CELEBRATING 70 YEARS OF INNOVATIVE TECHNOLOGY | UNPARALLELED CUSTOMER SERVICE

Read and follow all label directions. The Cleary logo is a trademark of Cleary Chemical Corporation. TriStar is a trademark of Nippon Soda Company LTD. ©2006 Cleary Chemical Corporation.

RELAX

IT'S A NEXUS





LUCAS GREENHOUSES
George and Louise Lucas
Monroeville, New Jersey

“ After researching our options with price, product and service, we chose the Nexus Clear Sky Greenhouse. That’s because we always look for performance with anything we do. Purchasing a greenhouse is no exception. We now know what it means to “Relax, It’s a Nexus”. For the best run, call Nexus and experience the best quality people you can possibly work with. ”

- *George Lucas*

Depending on your needs, Nexus has a variety of open roof greenhouses—the Clear Sky, Atrium, and Dual Atrium.

CLEAR SKY GREENHOUSE...

The Nexus Clear Sky Greenhouse defines performance. Engineered for strength and built with galvanized Nex-Steel, it can withstand North America’s demanding climate and load requirements. Indeed with the Clear Sky patented Nex-Hood roof the house is perfect for hardening off crops while allowing the roof to partially open during inclement weather and for de-humidification. It can close within three minutes if necessary and has a full roof opening of up to 85 degrees. The result is hardier plants grown more economically. And it is affordable. There are even lease options. Find out what a performance greenhouse can mean to your operations. Call Nexus today.

Write in 200



ANSWERS@NEXUSCORP.COM
WWW.NEXUSCORP.COM | 800.228.9639



crop cultivation

rooting. But two other components are critical in the long term. The propagation environment is subject to broader environmental changes, and responding to these quickly requires regular and fre-

quent monitoring. Also, early disease signs can be spotted and rapidly dealt with before they spread. Secondly, record keeping helps prevent repeating past problems and forms a valuable knowl-

edge database for growers. Particularly when crops are unfamiliar or seasonal, knowledge from other seasons is a useful reminder in guiding current efforts and producing a more successful crop.

After Rooting

Hardening off, or toning, is the process where newly rooted cuttings are acclimated from the soft environment of the propagation area to the harsher greenhouse environment. Managing this transition in a timely and correct fashion will assure prior hard work is not lost. In order to prevent excessive stretching and etiolation, cuttings should be removed from the propagation area as soon as they are rooted. The time to rooting can vary from one to several weeks, so regular monitoring is important.

A sudden change from the propagation environment to the greenhouse should be avoided in favor of a gradual transition. The new plants should be "babied" along. If light intensities have been gradually increased and moisture amounts gradually decreased during propagation, cuttings will already be partially hardened-off prior to leaving propagation. Remember, a little stress actually encourages root development, so slight wilting is fine. If cuttings have been rooted in a fairly dark environment, be cautious about leaf scald when light intensities increase. A gradual transition to full sun will take a few days. **GPN**

Roland Leatherwood is a Ph.D. student in the Department of Horticulture Science at North Carolina State University. He can be reached at roland_leatherwood@ncsu.edu. Roberto Lopez is a Ph.D. student in the Department of Horticulture at Michigan State University. He can be reached at lopezro4@msu.edu. Amy Enfield is a Ph.D. student in the Department of Horticulture at Clemson University. She can be reached at aenfiel@clemson.edu.

Author's note: The authors wish to thank the cutting suppliers, greenhouses and suppliers that support cutting research at NCSU, Clemson and MSU.

LearnMore
For more information related to this article, go to www.gpnmag.com/lm.cfm/gp120602

Complete Greenhouse/Nursery Pest Control

Insects, Virus, Mold, Mildew
Apply Herbicides, Fertilizer, Growth Regulators
The AIRE-MATE® SYSTEM™

Dyna-Fog® ULV Chemical Applicators

Over 30 models to match your application.

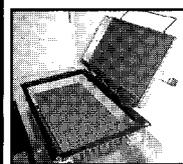


Expert service: Call Webster 1 800 544 8990 websterp@dynafo.com
AIRE-MATE, INC., Westfield, IN 46074 USA fax 317 896 3788

Write in 784



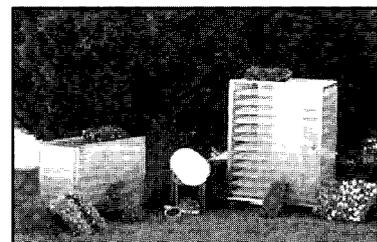
For Info and Ordering, Call
1-800-635-4532



Speedy Seeder
(Vacuum Seeder)

Offers Many Advantages

(Available with a Flip)
Easy to Use • Mounted Vacuum Seed Channel • Accurate Fast • Low Cost • Stainless Steel Construction • Seeds Melon to Raw Petunia, in cell pack or plug flats, in 10/20 and 13/26 flats • More efficient seeding.



Germination Chamber

Our Germination Chamber Enables You To Get Your seeds Off To A Faster Start. These Portable "Hot Houses" Feature Automatic Temperature Control • Stainless Construction • Polycarbonate Doors • Removable Doors and Shelves • Caster Wheels • Operates On Standard 110 Volt Outlet • Optional Water Reservoir Available.

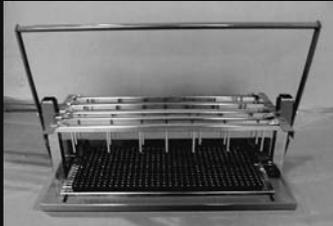
ARRIVES FULLY ASSEMBLED & READY TO USE!!!

P.O. Box 1140 • Kinston, NC 28503
Phone: 252-523-9300 / Fax: 252-523-3691
www.carolinagreenhouses.com

Write in 779

"ECONO POPPER"

- ♦ PORTABLE
- ♦ UNIVERSAL
- ♦ LIGHTWEIGHT
- ♦ HAND OPERATED
- ♦ ASSEMBLY REQUIRED



ADJUSTS TO FIT
ANY STANDARD
10" X 20" TRAY

WWW.PLUGPOP.COM



Antal/Cayson Equipment

7474 SE Johnson Creek Blvd • Portland, OR 97206
Toll Free (877) 758-4767 • Local (503) 775-5610

Write in 785

NEW!

DURA-BENCH

PLASTIC GREENHOUSE BENCH TOP

ultra

FOR LARGE SCALE COMMERCIAL APPLICATIONS

BENEFITS:

- INCREASED AIRFLOW
- EASIER CLEANING
- LESS EXPENSIVE
- RUST PROOF
- ROT PROOF
- UV PROTECTED
- LONG LASTING
- NO ROUGH EDGES
- NO SPLINTERS
- EASY TO INSTALL
- ATTACHES TO WOOD OR METAL FRAMES

SIZE / WEIGHT:

- 24" x 48" NOMINAL (60.96 cm x 121.92 cm)
- 4.5 LBS (2.04KG)

SOUTHWEST AGRI-PLASTICS, INC.®

16400 MIDWAY RD. | P.O. Box 70008 | PH. 972.735.8866
DALLAS, TX 75001 | DALLAS, TX 75370-0008 | FX. 972.735.8896

1.800.288.9748 **WWW.SWAPINC.COM**

Write in 732