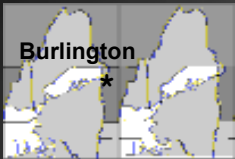



**Vegetative Perennials
propagation specifics**



Burlington *

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??Questions to Ask??

- Should I propagate or buy in?
depends on answer to...
- What is my interest? business focus?
- Do I “like” to propagate? retail?
- Greenhouse or nursery primarily?
- What is my target market?

You might propagate your own if...

- you have the facilities
- you have the labor/interest
- you have the time in your schedule
- you want more variety
- you have special/unique plants

Propagation options

- buy in all, or propagate all
- buy in easier, propagate harder
- buy in harder to propagate (vernalize), start easier on site
- buy in liners (rooted in media), or cuttings
 - rooted or unrooted

**Crop specifics
for vegetative perennials**

- Buying In
- Propagation
- Finishing
- Schedules
- Resources

Buying in-- considerations

- cost
- culture indexing
- timing
- size of plant/ rooted cuttings
- unrooted cuttings:source
 - domestic,offshore

Buying in --advantages

- saves time, labor, facilities (I.e. costs)
 - especially for greenhouses
 - shorter time to sale
- if “clean” material, less chance to carry over disease
- easier to schedule (liners)
 - rooting, vernalization (cold treatment for bloom) issues dealt with by propagator

Buying in-- disadvantages

- more costly if available facilities, labor, stock plants
- introduction of disease if not “clean”
- no propagation if desire to do so
- less cultivars of some plants
 - on other hand...others (patented, tc) often *only* available from licensed propagators
 - increasing number available (plugs too)

Buying in cuttings-- other disadvantages

- availability of desired selections
 - may need multiple sources
- shipping and customs costs
- some species not allowed into USA from offshore

Develop good communication with broker

Buying in liners-- timing to buy

- depends on type operation, schedules
- late summer-- pot, overwinter (vernalize) 28-41F (-2 to 5C) or outdoors
- fall-- overwinter covered
- early spring-- pot and finish for spring, force bloom?
- spring-- pot and finish for summer

Buying in liners-- size depends on

- type of operation
- schedules, space, other crops
- same choices as for propagation (16-128, often 30/50/70/90)
- cost to buy vs. cost for space/labor
- finish size
 - larger initially for larger pots, or several smaller per large pot
 - larger finish quicker

Buying in liners-- Nursery schedule

| time | liner | pot |
|-------------|---------|-----------|
| summer | 90 | jumbo |
| | 50/72 | gal |
| late summer | 32 | jumbo-gal |
| | 50/72 | jumbo |
| | 2x72/90 | gal |
| early fall | 32 | jumbo |
| | 2x32/50 | gal |

Buying in liners-- Greenhouse schedule

| time | liner | pot |
|--------------|-----------|--------|
| summer* | 32/50 | jumbo |
| | 72/90 | 2/gal |
| early fall** | 72/90 | 4-inch |
| late fall** | any | spring |
| spring | as finish | |

* for fall sales, ** overwinter

Buying in/own liners-- overwintering temperatures

| | |
|-----------|---|
| 1-15 Oct | begin temp. drop from 60-65F (16-18C), 5F(3C) per week, 6 weeks |
| 15-30 Nov | reach 28-41F (-2 to 5C) air |
| 15-28 Feb | ramp temp. up |
| 1-15 Apr | reach 65F (18C) day/ 55F (13C) night |

•vernalization provided

•often combination with nursery

Buying in cuttings offshore considerations

- unrooted cuttings
 - need facilities to root, so often left to propagators/ "rooting stations"
- make sure clean, indexed
- may take several days longer than domestic, possibly decreasing quality
 - excess respiration, light exclusion, moisture loss, pathogens, ethylene increase

Receiving cuttings

- act promptly
- verify varieties, count, quality
- check for consistency
 - size (length, diameter), age
- check for injury
 - pests, freeze, dehydration, rots
 - report problems then not later
- stick as soon as possible

Unrooted cutting storage

- only if necessary before sticking
 - buying in, or if taking own cuttings
 - reduce carbohydrate loss
 - one week or less best
- cool 35-45F (2-7C)
- high humidity (90% RH)
- reduced oxygen, ethylene
- increased carbon dioxide (CA storage)

Crop specifics for vegetative perennials

- Buying In
- Propagation
- Finishing
- Schedules
- Resources

10 keys to success with vegetative propagation

- Stock plants
- Propagules
- Media
- Hormones
- Humidity
- Temperature
- Light
- Water
- Fertility
- Sanitation

Propagation– stock advantages

- If retailer, also use for display
- maintain hard-to-find, not readily available selections
- you have a propagation “trick”
- maintain own selections, often from “sports”
- have the space, facilities, labor

Propagation– stock issues

- requires space to maintain
- may be carrying disease
 - within species, cultivars
 - to infect adjacent annual crops
 - can get infected even if bought clean
- not set up to propagate
- may be difficult to coordinate maximum vigor, vegetative with scheduling (i.e. forcing)

Propagation– stock maintaining plants

- may grow indoors for access year round
- keep 2-3 years max, yearly better
- young is easiest to work, roots better, less chance for disease
- may repot to sell, root offsets
- buy “clean” starters, virus indexed, especially if greenhouse

Propagation– stock plant quality

- maximum carbohydrates
 - good nutrition (moderate nitrogen), high light, root restriction, no water stress, shoots where rapid growth ceased
 - 150ppm N after cutting, 75ppm N with shoot elongation, 0ppm few days prior to recutting
- free from disease, pests
- early morning cuttings may be best (more turgor--moisture content)

Propagation– stock the key to cutting success

- maximum carbohydrates
- Juvenile growth--uniform
 - Nodes of same age, slightly hardened
- consistency age, length, diameter
- otherwise less yield (rooting), less uniformity of crop
- hormones make up some for poor stock or cuttings

Propagation— stock range of methods



Certified, greenhouse



Crates, nursery

Vegetative propagation— methods, choices

- grower size
- plant habit
- timing
 - many plants provide choices, eg. *Achillea* by Division spring/fall, Stem cutting in mid-summer
 - forcing (vegetative), indoors extends cutting period

Vegetative propagation— methods by grower size

- small:
 - often more of own media and methods,
 - diverse crops, seed plugs, own or bought
 - specialists, own cutting or tc
- medium: mix own, buy in liners/rooted cuttings/seed plugs
- large: unrooted cuttings, often offshore, own or contracted; seed plugs, own or bought

Vegetative propagation-- stem cuttings

- tip, terminal
 - cut just below node, avg. 3 nodes per cutting
 - eg. *Amsonia*, *Euphorbia*, *Phlox subulata*
- stem, leaf node, internodal
 - section of stem, root at leaf nodes
 - eg. *Agastache*, *Ajuga*, *Chelone*, *Lamium*
- leaf--leaf with small section of stem (eg. *Sedum*)
- most common method
 - most further comments on

Vegetative propagation-- stem cutting sticking

- A few have better winter survival with node below surface
 - *Caryopteris*, *Monarda*, *Phlox paniculata*
- Some difficult to root, slit lower stem vertically at base
 - some *Dianthus*

Vegetative propagation-- other cuttings

- basal-- at base of plant where tops join roots
 - if roots attached, root primordia, “heel” or “rooted” cuttings
 - early as plants sprout
 - eg. *Achillea*, *Aster*, *Coreopsis*, *Geranium*
- rhizome-- underground stem
 - treated similar to root cuttings
 - eg. *Bergenia*, *Darmera*, *Dicentra*

Vegetative propagation-- root cuttings: which plants?

many possible in winter

| | |
|-------------------|--------------------------------|
| <i>Acanthus</i> | <i>Ligularia</i> |
| <i>Bergenia</i> | <i>Lysimachia</i> |
| <i>Cimicifuga</i> | <i>Phlox paniculata</i> |
| <i>Dictamnus</i> | <i>Pulmonaria</i> species |
| <i>Eryngium</i> | (cultivars by division, tc) |

Vegetative propagation-- root cuttings: size

- thicker the better, pencil size ideal
- thicker the roots, more orientation seems to matter in placing upright in cells
 - *Acanthus, Anchusa, Asclepias, Brunnera, Papaver*
- mark roots with angle cut on bottom, straight tops
- take 1-2" long

Vegetative propagation-- root cuttings: process

- stick thicker in 50-70 tray to root, orientation?
- scatter thin roots on mix
 - make sure covered with mix
- water, keep fairly dry until rooted (4-8 weeks)
- alternative: throw in bag of just moist mix, remove and pot as root

Vegetative propagation-- root cuttings



roots bundled, cut

Vegetative propagation-- division

- pull offsets/rosettes from crowns with root initials
 - eg. *Hemerocallis, Heuchera, Leucanthemum*
- crown division
 - pull apart, cut woody crowns (eg. *Astilbe, Epimedium*)

Vegetative propagation-- tissue culture considerations

- few do their own, often contracted or purchased rooted/acclimated
- many new cultivars, choice ones, fast
 - (eg. *Heuchera, Tiarella, Hosta, Pulmonaria*)
- requires skill, expensive lab
- possible mutations (pro or con)
- increasingly common source

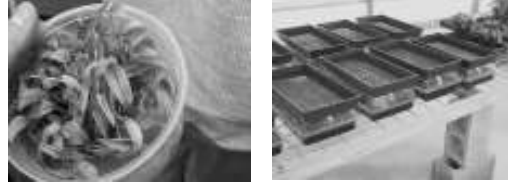
Vegetative propagation-- handling tissue culture

4 stages

--differing hormones, environment for each

1. establishment in agar media
2. microshoot formation
3. root formation
--usually obtained after stage 3 (rooted)
4. acclimation (to media, open)
--begin with 75-80% shade, high RH, 14-16hr days (fluorescent tubes)
--reduce with new leaves

Vegetative propagation-- tissue culture stages



Stage 3

Stage 4

Vegetative propagation— container type

- done in plug trays or open flats
 - plug trays--direct stick, more space on bench, most common
 - flats--need to transplant rooted, more labor
- open-mesh benches often best
 - more air so less disease
 - root pruning

Vegetative propagation— container size

- unit size depends on plant size, habit, propagation method
 - generally 16, 30/32 (or deep), 48/50, 60, 72, 94/96, 125/128
 - often two choices (small, large)
 - cuttings/tc take smaller, divisions larger (seeds even smaller)

Propagation— media choices

- There is no perfect media, only better or worse choices depending on growing system
- decisions often management and business as much as horticulture
- best: pick one, stick with it

Propagation— media considerations

- if change, change practices?
- important, don't skimp--use best
- pasteurized
- just moist enough
- keys: maintain moisture, high levels of oxygen, hold cuttings upright

Propagation– media components

- some nutrients, more in growing-on mix
- peat-lite media commonly used
- sand, sand and peat (1:1), perlite, perlite and vermiculite (1:1)
- gritty (alpines): sand, peat, pea gravel (1:1:1)
- loamy (woodland, ferns): loamy soil, peat moss, perlite or vermiculite (1:1:1)
- foam cubes (more for other crops)

Propagation– media for cuttings

- fine texture often important
 - fine cuttings (eg Coreopsis Moonbeam)
- don't want to break stems inserting
- want good media:cutting contact
 - 90% of cuttings water through stem

Propagation– hormones

- generally not need to root, but...
 - use of often decreases rooting time
 - Increases rooting uniformity
 - helps offset poor cuttings, stock
- IBA or IBA-K main *auxins* used
 - promote root formation
- Liquid– dip cutting end, or spray w/in 24hrs
- Powder– dip cutting ends

Propagation– hormone considerations

- Powders– harder to apply uniform, variable results
- Liquids– IBA often alcohol base, can damage growing points
 - twisted foliage
- IBA-K salt dissolves in water, no phytotoxicity

Propagation– hormone specifics

- 500-1,500ppm, quick end dip
- Generally IBA works as well as IBA+NAA
- Hard to root: IBA 10,000ppm+NAA
 - Woody stems
 - 5 sec. end dip (not more)

Propagation– hormones combination

Some perennial cuttings respond well to IBA 10,000ppm+NAA:

| | |
|------------------|-------------------------|
| <i>Aruncus</i> | <i>Lavandula</i> |
| <i>Baptisia</i> | <i>Phlox paniculata</i> |
| <i>Echinacea</i> | <i>Thermopsis</i> |
| <i>Geranium</i> | <i>Tiarella</i> (heel) |
| <i>Heuchera</i> | |

Propagation– humidity goals

- reduce transpiration, prevent wilting
- high humidity
- decreased evaporation
- mist only as needed, wet not dripping
 - more water is not better
 - leaches nutrients, diseases, low oxygen in media reduces rooting

Propagation– humidity means

- until rooted turn off fans, mist or fog (watering insufficient), decreased light
- gradually increase air and light, decrease mist/RH with rooting
- average 7-10 days callus, root hairs; 2-4 weeks initial rooting 4-6 weeks fully rooted (72 or 128 cells)

Propagation-- humidity from mist

- generally one to two weeks
 - depends on facility, season, location
 - longer intervals/stop as roots start
- may inject bromine into water, lessen algae and disease, alternative to chlorine
- timers or “leaf sensors”
 - better control, zones, too moist for some?



Propagation-- humidity from fog

- commercial foggers (large scale), humidifiers (short lived), orchid foggers
 - less water loss than mist
 - less nutrient leaching
 - less effect on media temperatures
 - may help hard-to-root, silver foliage (may rot under mist)
 - keep light high or fewer roots



Propagation– temperature rooting media

- Key, air temp. less effect rooting
- often 10F (5C) below air temp.
- media 65-75F (18-24C), may reduce as roots develop
- higher promotes root initiation
- lower may promote root growth
- bottom heat, many methods
 - until roots reach cell bottom

Propagation– temperature cool rooting media

Some perennial cuttings respond well to cool media 58-65F (14-18C):

| | |
|--------------------|---------------------|
| <i>Aurinia</i> | <i>Dicentra</i> |
| <i>Campanula</i> | <i>Erigeron</i> |
| <i>Centaurea</i> | <i>Geranium</i> |
| <i>Centranthus</i> | <i>Helianthemum</i> |
| <i>Chrysogonum</i> | <i>Polemonium</i> |
| <i>Delphinium</i> | <i>Tiarella</i> |

Propagation– temperature warm rooting media

Some perennial cuttings respond well to cool media 68-75F (20-24C):

| | |
|-------------------|-------------------|
| <i>Agastache</i> | <i>Hibiscus</i> |
| <i>Asclepias</i> | <i>Oenothera</i> |
| <i>Baptisia</i> | <i>Penstemon</i> |
| <i>Eupatorium</i> | <i>Perovskia</i> |
| <i>Gaura</i> | <i>Rosmarinus</i> |
| <i>Helenium</i> | <i>Salvia</i> |

Propagation– air temperature

- **Best: lower air than root temp.**
 - Decrease stem elongation, less mist
- **70-80F (21-27C) day, 60F (15C) night, or with bottom heat 65-70F (18-21C) or w/out 75-80F (24-27C)**
- **higher promotes bud development**
- **don't want buds before roots, uses up carbohydrates needed for roots**
 - same issue as with daylength

Propagation– light levels

- **balance not too much (<2000fc)**
 - Evaporates moisture, dehydrate
- **not too little (>1000fc)**
 - Needs to make food for growth
- **start low, increase as rooting**
- **summer: may need 50% shade**
 - Ideal: remove if cloudy (curtains)
- **winter: may need to supplement**

Propagation– light duration

- **most don't control photoperiod**
- **varies, complex, LD often best**
 - < 13hrs
- **may affect bud/shoot growth also**
- **may be problem if out of season**
- **guide--light for vegetative growth**
- **some (eg Sedum) should be veg.**

Propagation– water

- **(mist) temperature 50-70F (10-21C)**
- **winter watering: less is best**
- **low salts, bicarbonates, alkalinity**
 - these can delay rooting, lower quality
- **sulfuric, phosphoric acids common**
 - May react with calcium for residue
- **nitric acid best to neutralize**
 - Nutrients result, no residue

Propagation– fertility

- **not during first few days**
- **begin low levels once rooting begins (7-10 days)**
 - 50-100ppm N (nitrates) once/wk
- **increase once rooted (2-4 weeks) or if chlorotic**
- **natives establish fine at low levels**
 - species vs highly bred cvs.

Propagation– sanitation, insects

- in addition, not substitute, for proper environment and culture
- disinfect any/all surfaces/tools
 - Bleach (1:9 water ppv), products
- start with clean stock
- watch for fungus gnats
 - larvae eat roots
 - biologicals, IGRs, chemicals for larvae
 - apply early in propagation

Propagation– diseases

- watch for botrytis on young cuttings
 - some apply preventative broad spectrum fungicides, weekly until rooted, end of day with less mist
- many use fungicide drench in first week to prevent soilborne disease
- bacterial disease with high temps (85F/29C), excess mist, wet media
 - Copper-based fungicides

Crop specifics for vegetative perennials

- Buying In
- Propagation
- Finishing
- Schedules
- Resources

Finishing-- timing

- cell/unit size
- finish size
- plant or cultivar
- greenhouse temperature
 - avg. target 65F (18C) day, 55F (13C) night
- daylength

Finishing-- general schedule, Spring

- to 4-inch pot, from
 - 72: 4-5 weeks, 50: 3-4 weeks
- to quart from 50, 72: 4-7 weeks
- to gallon, from
 - 72: 8-10 weeks, 50 or larger: 5-8 weeks
 - add a plug, subtract a week or two

Finishing-- potting dates for 1 May sales, from 72 cells

| <u>Finish size</u> | <u>Transplant</u> |
|--------------------|-------------------|
| 4-inch | 21-28 Mar |
| quart | 14-21 Mar |
| gallon* | 15-28 Feb |

*subtract 1-2 weeks if additional plant
Dates will vary with location, plant, culture

Finishing--
potting dates for 1 May sales, from 50 cells

| <u>Finish size</u> | <u>Transplant</u> |
|--------------------|-------------------|
| 4-inch | 1-7 Apr |
| quart | 21-28 Mar |
| gallon* | 1-21 Mar |

*subtract 1-2 weeks if additional plant
Dates will vary with location, plant,
culture

Finishing--
fertility

- liquid: 20-10-20, 15-5-15 or similar
 - once/wk
 - 200ppm slow growers, 100ppm for fast
- controlled release fertility (CRF)
 - incorporate, top-dress, combine with half strength liquid
 - often better, faster growth than liquid alone

Finishing-- light

- daylength extension for long day (LD) species (forcing into bloom earlier)
 - to 16 hours, incandescent
 - may vary with species, cv., cold
- may help
 - *Astilbe, Coreopsis, Leucanthemum, etc.*
- may be required for bloom
 - *Campanula, Coreopsis, Echinacea, Gaillardia, Oenothera, Phlox, Rudbeckia, Sedum, etc.*

Finishing--
growth (height) regulation

- water less for some species, to initial wilt
- cut back 3 weeks prior to shipping
- DIF for many perennials
 - night=day temperature (65F avg., 18C)
 - sunrise, lower by 5-10F (3-6C) for 2 hours
- less fertility (low P eg. 15-5-15, or alternate 20-10-20 and 15-0-15)
- end of day red light (similar to DIF)?
- thigmotropism--mechanical touch

Finishing--
plant growth regulators (PGRs)

- generally only if other methods not possible
- most perennials/species not listed: trial
 - some specific plants in guides (eg. Ohio, Cornell, New England), labels
- A-Rest: many species, begin trial at 20-50ppm spray, 1-2ppm drench
- Bonzi: begin trial at 15ppm spray, 0.5ppm drench
- Sumagic: begin trial at lowest rates, 5-40ppm spray, 0.1-1.0ppm drench

Crop specifics for vegetative
perennials

- Buying In
- Propagation
- Finishing
- Schedules
- Resources

Vegetative propagation-- propagation timing

| | cutting | division |
|--------|----------|-----------|
| winter | root | stock in |
| spring | stock in | stock out |
| summer | stem | stock out |
| fall | some | some |

Easiest when plant wants to be vegetative
and not reproductive

Vegetative propagation-- production timing

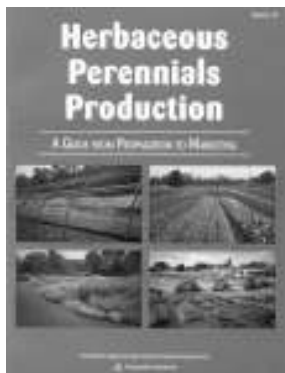
- winter: pot indoor stock divisions, root cuttings for same season sale
- spring: pot winter root cuttings, spring divisions, liners for same season sale
- summer: pot stem cuttings (as for buying-in liners), pot summer divisions
- late summer/early fall: pot cuttings as for buying-in liners, pot fall divisions

Vegetative propagation-- doing it better

- observe, keep good records
 - helps refine, improve in future
 - all details eg. stock, quality, temperatures, misting, chemicals, etc.
- don't be afraid to try new approaches
- persistent, don't give up
- share with others
 - ideal: they'll share, win:win for all

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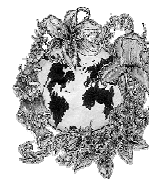


NRAES
607-255-7654
www.nraes.org

For more information...

Perennial Plant Association
www.perennialplant.org

Perry's Perennial Pages
perrysperennials..info



Perennial Solutions,
Paul Pilon