
SW Michigan Perennial Growers Workshop: Handling Perennial Plugs

Types of plugs

Standard plugs

- Large availability range, may be year-round from some suppliers
- Generally a wide range of sizes available: small (338, 250), medium (128, 72), and large (32, 55, 50)

Cooled plugs

- Don't be alarmed at the appearance of cooled trays
- The top growth of many species dies back, but roots remain alive and active
- Ideal for finishing under cool growing conditions
- Generally seasonal availability, and limited sizes (128, 50, 72, 32)
- May be juvenility issues – not all cooled plugs are vernalized

Choosing a plug

Base your decision on which plug to use on

- Finish container size
 - Larger plugs are easier to finish in gallon+ containers, and 2-3 plugs may be required
 - Larger containers take longer to fill out than smaller containers
- Production schedule
 - Larger plugs generally finish faster than smaller plugs
 - The earlier you plan ahead, the more likely you can use smaller plugs
- Program goals (green vs. flowering sales)
 - Understand keys to flowering for specific cultivars you grow
 - Choose the right plug for your goals – may need vernalized plug for some items
- Budget
 - Smaller plugs are generally more economical
 - Cooled/vernalized plugs have a premium price
- Level of expertise
 - Can be challenging to use small plugs to fill gallon and larger containers
 - Experienced growers may be able to use smaller plugs, without sacrificing quality

Receiving

When plugs arrive

- Check packing list against what was received, note substitutions and downcounts
- In cold weather, allow plugs to warm up to ambient temperature before putting in bright sunlight
- Best to transplant within 1 week of receiving
- If plugs must be held, maintain moisture and feed levels for best results

Transplanting

- Dislodge plugs from underneath for best results
- Don't plant too deep
- After transplant culture is critical first few weeks after transplant
 - Best to soak plugs with fertilizer solution about 15 minutes before transplanting
 - Do not saturate the growing medium after transplant
 - If you apply fungicide drench, consider drenching plugs before transplant

Finishing perennials

Understanding “cookbooks”

- Try to understand *why* a production plan calls for a given treatment
- Don't expect someone else's “cookbook” to automatically work perfectly in your system!
- Don't expect a schedule for one cultivar to always work the same for another cultivar!
- Don't expect a schedule for one sales window to always work the same for another sales window!
- A poor quality blooming perennial will be less saleable than a high quality green perennial

Providing Long Days

Perennials which require long days to flower can be flowered out of season with supplemental lighting

- Under 14 hour or shorter photoperiods, provide artificial long day
 - Night break lighting (10 pm – 2 am) is recommended
 - Incandescent, fluorescent, HID light is acceptable
- Will get some stretch, especially with incandescent
- To minimize stretch, turn lights off after flower buds appear
- Provide 5-10 footcandles minimum (1.25 watts/ft² for incandescent, 0.3 watts/ft² for HPS)
- Providing night break lighting during times of natural long day photoperiods can accelerate flowering 7-14 days for some long day perennials

Cooling & vernalization

Many perennials (both seed and vegetative) need to go through a cold period in order to flower, or flower much more quickly after receiving cold treatment.

- Vernalization = cooling a perennial long enough to cause it to bloom when it is warmed up.
- Successful vernalization depends on:
 - Maturity of the plant
 - Length of the cooling period
 - Cooling temperature
- Only when mature plants are cooled for the proper length of time and at the proper temperature is vernalization successful
 - Cooling juvenile plants can lead to sporadic flowering, greatly increased time to flower, or failure to flower
 - In general, older plants are less likely to be juvenile
- Even if not vernalized, cooled plugs typically have a better developed root system and produce fuller growth with better secondary shoot development than standard plugs. This can lead to fuller plants with more breaks, giving better pot fill

Pros and cons of finishing strategies for perennial plugs

Technique	Sales windows	Pros	Cons
Using standard plugs	<ul style="list-style-type: none"> • Early spring • Spring • Summer • Fall 	<ul style="list-style-type: none"> • Longer availability than cooled plugs • Can schedule for any sales window • Excellent for growers new to perennials • Fit easily into warm growing production system 	<ul style="list-style-type: none"> • Cultivar choice limited if flowering desired • Flowering may be delayed or less full compared to cooled plants
Using cooled plugs	<ul style="list-style-type: none"> • Early spring • Spring • Summer 	<ul style="list-style-type: none"> • No need to maintain plants through the winter • Adapted to cool growing conditions • Shorter crop time than fall planting • May finish fuller than standard plugs 	<ul style="list-style-type: none"> • Limited time of availability each year • Vernalization usually not guaranteed • May have premium price
Fall planting	<ul style="list-style-type: none"> • Early spring • Spring • Early summer 	<ul style="list-style-type: none"> • Can use small, economical plugs • Overcomes juvenility in many species • High quality finished plants 	<ul style="list-style-type: none"> • May require overwintering facilities • Long crop time • Somewhat limited sales windows • Losses can occur during overwintering

Perennials which flower without cooling

By providing the proper photoperiod, these perennials can be flowered for spring, summer, or fall sales. Cooling may be beneficial for some items, decreasing bench time and/or increasing finish quality and uniformity. Schedules based on 128 cell plugs transplanted 1 per pot for quart and smaller containers, 3 per pot for gallon, and growing temperatures of 60-68 °F (unless otherwise indicated), under the proper photoperiod. Larger plugs may finish 2-4 weeks faster, smaller plugs 2-4 weeks slower. In gallon containers, some species may require 1-2 additional weeks to flower.

Plant	Photoperiod*	Weeks to flower	Days bud to flower	Height (inches)
<i>Achillea millefolium</i> 'Summer Pastels', 'Colorado'	LD	8-10	20	12-18
<i>Achillea ptarmica</i>	LD	5-7	14	16-24
<i>Agastache foeniculum</i> cultivars	LD	6-8	14	24-36
<i>Anchusa capensis</i> ‡	DN	9-10	20	8-12
<i>Armeria pseudoarmeria</i> 'Joystick' series	LD	10-12	12	18-24
<i>Asclepias tuberosa</i> ††	LD	8-10	20	12-14
<i>Calamintha nepetoides</i>	LD	6-7	18	12-18
<i>Campanula carpatica</i> 'Clips', 'Star', 'Uniform' ‡	LD	7-9	20	6-8
<i>Campanula cochlearifolia</i> cultivars	LD	6-7	14	6-10
<i>Campanula rotundifolia</i>	LD	5-6	10	12-14
<i>Catananche caerulea</i>	LD	10-12	24	24-28
<i>Centaurea montana</i>	LD	7-8	24	12-16
<i>Centranthus ruber</i>	LD	6-8	14	24-36
<i>Coreopsis grandiflora</i> 'Early Sunrise'	LD	10-12	28	18-24
<i>Cynoglossum amabile</i> 'Mystery Rose'	DN	8-10	20	12-16
<i>Delphinium grandiflorum</i> cultivars † ‡	DN	8-10	20	20-24
<i>Dianthus x allwoodii alpinus</i> †	DN	7-8	16	8-12
<i>Dianthus barbatus</i> 'Rondo Mix' †	DN	7-8	20	6-8
<i>Dianthus deltoides</i> 'Arctic Fire', 'Zing Rose' †	DN	7-8	14	4-6
<i>Dianthus gratianopolitanus</i> 'Grandiflorus' †	DN	8-10	20	8-14
<i>Digitalis grandiflora</i> 'Temple Bells', 'Carillion'	DN	7-8	14	12-16
<i>Helenium autumnale</i> 'Red & Gold Hybrids'	LD	12-14	12	30-42
<i>Heliopsis helianthoides</i> **	LD	8-10	22	30-36
<i>Hibiscus x hybrida</i> cultivars **	LD	9-12	45	24-30
<i>Lavandula angustifolia</i> 'Lady'	LD	8-10	24	12-16
<i>Leucanthemum (Chrysanthemum) x superbum</i> 'Silver Princess', 'Snow Lady', 'White Knight'	LD	8-10	25	10-14
<i>Linaria purpurea</i> 'Canon J Went'	LD	8-10	14	20-30
<i>Lobelia siphilitica</i>	LD	10-12	20	24-32
<i>Lobelia x speciosa</i> 'Compliment', 'Fan' Series	LD	9-10	24	18-30
<i>Lupinus x hybrida</i> 'Gallery' Series ‡	LD	8-9	14	20-24
<i>Lychnis x haageana, x arkwrightii</i> cultivars †	DN	6-7	15	8-12
<i>Oenothera missouriensis</i>	LD	9-11	24	10-12
<i>Papaver alpinum, nudicaule</i> cultivars † ‡	DN	6-8	14	12-24
<i>Platycodon grandiflorus</i> 'Sentimental Blue' F1 ††	LD	6-8	18	4-6
<i>Platycodon grandiflorus</i> 'Astra' series, 'Mariesii'	LD	9-11	24	16-24
<i>Rudbeckia hirta</i> cultivars	LD	8-9	16	10-24
<i>Rudbeckia triloba</i> **	LD	15-16	36	36-42
<i>Sagina subulata</i>	LD	5-6	8	3-4

* LD indicates long days are required or beneficial for flowering ** Better performance when grown warm, 70-75 °F

† Provide additional 2-3 weeks for flowering under short days †† Pinch at transplant for better pot fill

‡ Prefers cool growing temperatures, not good for summer sales window

Southwest Michigan Perennial Growers Workshop: Handling Perennial Plugs
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Perennials which can be vernalized as plugs

Cooled perennial plugs are ideal for finish growing under cool temperatures for early and late spring sales. Items on this list can also be planted in fall, and will finish at approximately the same schedule (or up to 1-2 weeks earlier) after overwintering. This schedule is based on mature plugs cooled 10 weeks at 38-41 °F and 60-68 °F growing temperatures (unless otherwise indicated), under the proper photoperiod. In gallon containers, 1-2 additional weeks may be required.

Plant	Photoperiod*	Weeks to flower	Days bud to flower	Height (inches)
<i>Aquilegia alpina</i> †	DN	6-8	10	10-14
<i>Aquilegia vulgaris</i> , <i>x hybrida</i> (<i>cultorum</i>) cultivars †	DN	6-7	10-12	10 - 18; 24 - 36
<i>Arabis caucasica</i> cultivars ‡	DN	3-5	7	4-6
<i>Astilbe chinensis</i>	LD	12-15	30	8-16
<i>Astilbe chinensis</i> var. <i>taquetii</i>	LD	12	32	20-32
<i>Aubrieta x hybrida</i> 'Grandiflora', 'Whitewall Gem'	DN	9-10	7	6-8
<i>Bellis perennis</i> cultivars ‡	DN	6-8	12	8-10
<i>Coreopsis grandiflora</i> 'Sunray', 'Baby Sun' †	LD	6-8	20	20-30
<i>Delphinium x belladonna</i> cultivars	DN	8-9	20	20-28
<i>Delphinium x elatum</i> 'Magic Fountains' series	DN	8-10	20	18-28
<i>Dianthus barbatus</i> 'Double Dwarf', 'Indian Carpet'	DN	8-9	12	6-8; 8-12
<i>Digitalis grandiflora</i> (<i>ambigua</i>)	DN	6-8	16	14-18
<i>Echinacea purpurea</i> cultivars **, ***	LD	10-12	24	36-48
<i>Gaillardia x grandiflora</i> cultivars ***, †	LD	7-9	20	10-18; 24-28
<i>Geum chiloense</i> 'Lady Stratheden', 'Mrs. Bradshaw'	DN	8-10	10	12-16
<i>Heuchera sanguinea</i> cultivars †	LD	7-8	18	14-30
<i>Leucanthemum (Chrysanthemum) x superbum</i> 'Alaska', 'G Marconi' ***	LD	7-8	24	24-36
<i>Myosotis sylvatica</i> 'Victoria' series ‡	DN	5-7	14	6-10
<i>Physostegia virginiana</i> 'Alba'	LD	10-12	26	20-30
<i>Physostegia virginiana</i> 'Rosea'	LD	12-15	30	30-36
<i>Platycodon grandiflorus</i> 'Fuji' Series	LD	10-12	30	24
<i>Polemonium caeruleum</i>	LD	4-6	12	20-26
<i>Primula x polyantha (elatior)</i> , <i>x pruhoniciana</i> ‡	DN	7-8	15	4-10
<i>Rudbeckia fulgida</i> 'Goldsturm' †, **, ***	LD	12-14	30	18-24
<i>Saxifraga x arendsii</i> 'Purple Robe'	DN	5-7	7	6-8
<i>Veronica spicata</i>	LD	6-8	18	18-24

† These plants have a relatively long juvenility period and large plugs are recommended to ensure flowering.

* LD indicates long days are required or beneficial for flowering

** Better performance when grown warm, 70-75 °F

*** Multiple plugs per pot recommended. Fuller plants and better pot fill when planted in fall and overwintered.

‡ Prefers cool growing temperatures, not good for summer sales window

Perennials for fall planting

These perennials have long juvenility periods or produce better filled pots when plants with a large root mass are vernalized. This schedule is based on established pots cooled at least 10 weeks at 38-41 °F, and 60-68 °F finish growing temperatures (unless otherwise indicated), under the proper photoperiod.

Plant	Photoperiod*	Weeks to flower	Days bud to flower	Height (inches)
<i>Achillea millefolium</i> cultivars	LD	9-10	24	20-24
<i>Aquilegia alpina</i>	DN	6-7	10	10-14
<i>Aquilegia flabellata</i> 'Cameo' Series †	DN	4-5	7	4-8
<i>Aquilegia vulgaris</i> , <i>x hybrida</i> (cultorum) cultivars	DN	6-7	10-12	10 - 18; 24 - 36
<i>Aster alpinus</i> cultivars	LD	5-6	14	14-20
<i>Aster tongolensis</i> 'Wartburg Star'	LD	7-8	28	18-24
<i>Astilbe chinensis</i>	LD	12-14	30	8-16
<i>Astilbe chinensis</i> var. <i>taquetii</i> (<i>A. taquetii</i>)	LD	10-12	32	20-32
<i>Aurinia saxatilis</i> 'Compactum'	DN	5-7	10	10-14
<i>Campanula glomerata</i> cultivars	LD	7-8	24	18-24
<i>Campanula persicifolia</i> cultivars	LD	10-12	30	36-42
<i>Coreopsis grandiflora</i> 'Sunray', 'Baby Sun'	LD	6-7	20	20-30
<i>Dianthus caryophyllus</i> 'Grenadin' Series	DN	7-9	26	18 - 24
<i>Digitalis purpurea</i> cultivars	DN	10-11	14	24-36
<i>Doronicum orientale</i> cultivars	DN	7-8	6	18 - 30
<i>Echinacea purpurea</i> cultivars **	LD	10-12	24	36-48
<i>Gaillardia x grandiflora</i> cultivars	LD	7-8	20	10-18; 24-36
<i>Heuchera sanguinea</i> cultivars	LD	7-8	18	14 - 30
<i>Iberis sempervirens</i> 'Snowflake'	DN	6-7	13	8 - 10
<i>Lavandula angustifolia</i> 'Hidcote Blue', 'Munstead Dwarf'	LD	6-7	20	12-20
<i>Leucanthemum</i> (<i>Chrysanthemum</i>) <i>x superbum</i> 'Alaska', 'G Marconi'	LD	7-8	24	24 - 36
<i>Lupinus x hybrida</i> 'Minarette', 'Russell' Series	LD	10-12	14	24-36
<i>Lychnis viscaria</i> 'Firebird', 'Splendens'	DN	5-6	9	18-24
<i>Lysimachia atropurpurea</i> 'Beaujolais'	LD	7-8	18	18-24
<i>Oenothera fruticosa</i> 'Youngii'	LD	9-10	20	24-36
<i>Potentilla megalantha</i>	LD	8	10	4-8
<i>Potentilla nepalensis</i> 'Miss Willmott'	DN	9-10	14	10-14
<i>Rudbeckia fulgida</i> (var. <i>sullivantii</i>) 'Goldsturm' **	LD	12-14	30	18-24
<i>Scabiosa caucasica</i> 'Fama', 'Perfecta Alba'	DN	10-12	24	30-36
<i>Tanacetum</i> (<i>Chrysanthemum</i>) <i>coccineum</i> cultivars	LD	7-8	18	24-36

* LD indicates long days are required or beneficial for flowering

** Better performance when grown warm, 70-75 °F

† Make sure plants are well established before cooling, or low quality plants will result