Department of Horticultural Science

Horticulture Information Leaflet 524
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COMMERCIAL HYDRANGEA FORCING

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The florists' hydrangea, *Hydrangea macrophylla* subspecies *macrophylla* var. *macrophylla* has been an important greenhouse crop for many years. Its popularity and production have both been increasing in the past few years. This leaflet outlines procedures for the greenhouse forcing of dormant, precooled hydrangeas.

Receiving and Establishing Pre-Cooled Plants

Hydrangeas are usually shipped in the late fall through early winter, after they have received a required cold storage treatment. They are received as dormant plants in 4 to 6 inch pots or as bare-root plants previously grown in 4 inch pots. Newly received plants should be allowed to initiate active root growth (for about 2 weeks) prior to transplanting into the final-sized pot. The ideal starting temperature for hydrangeas is a 60 to 62°F soil temperature supplied with bottom heat, while maintaining slightly cooler air temperatures (about 58°F). This allows root activity prior to bud opening on the shoots. Grow plants slightly on the "dry side" prior to transplanting to prevent root rot and to encourage root development. No fertilizer should be applied until root activity and transplanting have occurred.

One of the main problems encountered with hydrangeas is poor root establishment. This condition leads to water stress damage during late stages of forcing. The bottom of the root ball should be slit twice (to form an × pattern), about 1/3 of the way up towards the top to form four sections, when transplanting; split open these sections and place them in direct contact with the soil in the pot.

Flower Color Control

The key in assuring clear pink or blue inflorescences is ordering plant material programmed to develop the desired color and continuing the color program throughout forcing. Fertilization practices during the previous summer growth phase can affect coloration during forcing, and changing the color program during the forcing phase can result in undesirable shades of mauve sometimes referred to as "blurple" tones.

Whether a hydrangea (excluding white cultivars) develops a pink or blue inflorescence is dependent on the presence and availability of aluminum. The absence of aluminum assures pink flowers; high availability of aluminum leads to blue flowers. By regulating aluminum, flower color can be controlled.

Cultivars vary in color tones and some are better suited for pinks while others are best produced as a blue. Select the cultivar with the color and tone best suited for your market demands. Although there are over 500 cultivars of hydrangeas, only a few are produced in the U.S. (Table 1).

Pink Flowers. Avoid supplying aluminum to plants; do not use mineral

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Table 1. Description of the most common hydrangea cultivars.

Cultivar	Sepal color description		Relative days to flower*	Inflorescence size/plant height	Comments
	Grown as a pink	Grown as a blue			
Böttstein	Dark red	Not recommended	92	Medium/Short	
Brestenburg	Not recommended	Medium blue	83	Medium/Medium	Best medium blue
Enziandom	Light pink	Deep blue	92	Medium/Tall	
Kasteln	Dark pink	Medium blue	95	Medium/Short	Heat tolerant; good for late season forcing
Kuhnert	Not recommended	Medium blue	95	Small/Medium	
Mathilde Gütges	Not recommended	Light blue	95	Large/Medium	Best light blue
Merritt's Supreme	Dark pink	Medium blue	88	Large/Medium	Heat tolerant; good for late season forcing
Red Star	Light red	Medium blue	95	Large/Medium	
Rose Supreme	Light pink	Light blue	103	Very large/Very tall	Heat tolerant
Schenkenburg	Dark red	Not recommended	95	Medium/Medium	Best red
Sister Therese	White	White	95	Medium/Medium	Best white
Strafford	Dark pink	Not recommended	99	Large/Medium	Not heat tolerant; better for cool regions
Todi (Toddy)	Dark pink	Not recommended	88	Large/Medium	Not heat tolerant; better for cool regions

*Based on using a 60°F night/75°F day temperature up to 18 days prior to sale, then a 54°F night/65°F day for color intensification.

soil in the substrate and use fertilizers that do not contain aluminum. Use relatively high levels of phosphorus in the fertilizer program. Phosphorus antagonizes aluminum uptake and helps assure pink flowers. Incorporate 3 to 4.5 lbs treble superphosphate (0-45-0) per yd^3 into the substrate. Rotating mono-ammonium phosphate (11-53-00) into the feed program will also help raise phosphorus levels and help prevent aluminum uptake. An example feed program would be continuous feeding using 150 ppm nitrogen from 20-10-20 (10 oz/100 gal) rotated with 100 ppm nitrogen from 11-53-00 (18 oz/100 gal) every third feeding.

Try to maintain a substrate solution pH of 6.0 to 6.2; aluminum becomes more available at lower pH's. Be careful not to allow the pH to rise much above 6.4, or iron deficiency chlorosis will become a problem. If the pH of the irrigation water is higher than 6.5, consider acidifying to 6.3. Phosphoric acid would be the acidifier of choice for pink flowers, as it increases phosphorus levels in the substrate. Supply low to moderate levels of potassium. High levels of potassium tend to increase bluing of hydrangeas.

The cultivars recommended for a dark pink to red are 'Böttstein' and 'Schenkenburg'; medium pinks include 'Merritt's Supreme', 'Kasteln', and 'Red Star'; and 'Rose Supreme' and 'Enziandom' produce light pink flowers. Some cultivars such as 'Mathilde Gütges' and 'Brestenburg' do not produce a consistent or clear pink and should be programmed as blue flowers only.

Table 2. Recommend rates of B-Nine based on cultivar height and responsiveness to B-Nine.

Cultivar	Relative height	Response to B-Nine	Recommended rate of B-Nine
Böttstein	Short	Great	0–2500 ppm
Enziandom	Tall	Moderate	5000 ppm
Kasteln	Short	Great	0–2500 ppm
Mathilde Gütges	Medium	Moderate	2500 ppm
Merritt's Supreme	Medium	Slight	2500–3500 ppm
Red Star	Medium	Very slight	5000 ppm
Rose Supreme	Very tall	Moderate	5000–7500 ppm
Schenkenburg	Medium	Moderate	2500 ppm

Blue Flowers. Although dormant plants purchased as blues will have received aluminum sulfate prior to shipment, aluminum must also be supplied during the forcing period. Start drenching with aluminum sulfate immediately after transplanting. Apply 8 fl oz of drench per 6 inch pot using 10 lb aluminum sulfate per 100 gallons of water. Drenches should be applied to moist substrates only as drenching dry soil will result in damaged roots. Make applications at 10 to 14 day intervals. About 10 days after each application, measure the pH

Table 3. Temperature effects on forcing timing. The table is based on cultivars that bloom in 88 days (such as 'Merritt's Supreme') when forced using a 60°F night/75°F day up to flower color. The timings given below assume that temperatures will be dropped to 54°F night/65°F day during the last 18 days of forcing.

	Night temperature/ day temperature (°F)		
Time interval	54/65	60/75	66/75
Days from start of forcing to bloom (salable color)	112	88	80
Days from start of forcing to pea-sized inflorescence ($^3/_{16}$" diameter bud)	43	32	28
Days from pea-sized bud to bloom	70	56	52
Days from nickel-sized inflorescence ($^{13}/_{16}$" diameter bud) to bloom	53	42	39
Days from silver dollar-sized inflorescence (1 $^1/_2$" diameter bud) to bloom	35	28	26
Days from first color (drop temperature to 54°F night/65°F day) to bloom	18	18	18

of the substrate. If the pH is higher than 5.6, another application of aluminum sulfate should be made. Continue this procedure throughout forcing. The aluminum sulfate not only supplies aluminum, it also maintains a low (5.2 to 5.5) pH in the substrate solution, desirable during forcing of blue hydrangeas. If the pH of the irrigation water is higher than 5.8, add acid to drop the pH to 5.3. A 35% sulfuric acid source (available at most auto supply stores) is the best water acidifier when growing blue hydrangeas, as it will not add unwanted phosphorus (as would phosphoric acid) and is not as caustic as a more concentrated sulfuric acid or nitric acid.

Use a phosphorus-free substrate for transplanting and use a fertilizer lacking phosphorus. Apply high levels of potassium for increased bluing. For example, apply 150 ppm nitrogen and 300 ppm potassium at each irrigation supplied with ammonium nitrate (2 oz per 100 gal) plus potassium nitrate (11 oz per 100 gal).

Height Control

Most hydrangeas, especially tall growing cultivars (Table 2), require height control during forcing. Apply B-Nine® sprays using 2500 ppm (most cultivars) to 5000 ppm (tall cultivars, especially 'Rose Supreme'). Bonzi® sprays of 50 ppm are also labeled and effective for height control of hydrangeas. First applications of either growth retardant are made when 3 to 5 leaf pairs have begun to unfold, about 2 to 4 weeks after the start of forcing. Under low light conditions, repeat applications may be necessary at 10 to 14 day intervals. Treatments should be discontinued prior to when flower buds reach $^3/_4$ of an inch in diameter or inflorescences will be reduced in size at maturity.

Temperature and Timing

The rate of hydrangea development during forcing is directly related to average daily temperature, and to a certain degree, forcing speed can be regulated by adjusting temperature (Table 3). Generally, plants are forced in 80 to 100 days using 60°F nights/70°F cloudy day/75°F sunny day temperatures until sepals begin to show color (about 2 $^1/_2$ weeks to sales date) then dropping the temperature until full coloration. At start of color, the temperature should be dropped to 54°F night/65°F day to intensify flower color. Try to avoid excessively warm temperatures during forcing. Too warm forcing temperatures result in smaller plants, smaller inflorescences, less intense coloration, and a poorer quality plant than when plants are forced at cooler temperatures.

Hardening and Post-Production Handling

At the beginning of visible sepal color, fertilization should be cut in half to help harden plants. Fully colored flowers are tender, and some shading to prevent overheating is beneficial during the last few weeks of production, especially for late crops such as for Mother's Day. Watering should be slowly reduced, but under no circumstances should plants be allowed to wilt.

Hydrangeas exhibit a long post-harvest life in the home if kept moist, out of direct light, and relatively cool. The key word for retailers and home owners is ***Water***. Hydrangeas are severely affected by wilting and will never fully recover if allowed to dry out.

Pests and Diseases

Greenhouse pests and diseases differ from location to location. Consult with your County Cooperative Extension Service Center regarding effective, labeled prevention and control procedures. Listed below are the major problems of hydrangeas. Problems most likely to be encountered are indicated

by the "helping hands":

Insects

- ☞ Aphids (*Aphis gossypii, Myzus circumflexus, M. persicae*)
- Four-lined plant bug (*Poecilocapsis lineatus*)
- Leaf-tiers (*Exartema ferriferanum, Udea rubigalis*)
- Rose-chafer (*Macrodactylus subspinosus*)
- Scale (*Lepidosaphes ulmi, Pulvinaria spp.*)
- Tarnished plant bug (*Lygus lineolaris*)
- Thrips (*Hercinothrips femoralis*)
- ☞ Whiteflies (*Bemisia tabaci, Trialeurodes vaporariorum*)

Mites

- ☞ Two-spotted mite or Red spider mite (*Tetranychus urticae*)

Other pests

- Slugs (*Deroceras reficulatum, Limax spp.*)
- Snails (*Helix spp.*)

Bacteria

- Bacterial wilt (*Pseudomonas solanacearum*)

Fungi

- Blister rust (*Pucciniastrum hydrangeae*)
- ☞ Bud rot (*Botrytis cinerea*)
- ☞ Gray mold (*Botrytis cinerea*)
- ☞ Inflorescence blight (*Botrytis cinerea*)
- Leaf spots (*Ascochyta hydrangeae, Cercospora arborescentis, Corynespora cassicola, Phyllosticta hydrangeae, Septoria hydrangeae*)
- ☞ Powdery mildew (*Erysiphe polygoni*)
- Root rot (*Armillaria spp., Polyporus spp., Rhizoctonia spp., Sclerotium spp.*)
- Stem rot (*Polyporus spp., Rhizoctonia spp., Sclerotium spp.*)

Mycoplasma-Like Organisms (MLO)

- ☞ Hydrangea virescence

Nematodes

- Leaf nematodes (*Aphelenchoides spp.*)
- Lesion nematodes (*Pratylenchus spp.*)
- Root-knot nematodes (*Meloidogyne incognita, M. hapla*)
- Stem nematodes (*Ditylenchus dipsaci*)

Viruses

- Alfalfa mosaic virus
- Cucumber mosaic virus
- Hydrangea mosaic virus
- ☞ Hydrangea ring-spot virus
- Tobacco rattle virus
- Tobacco ring-spot virus
- Tobacco necrosis virus
- Tomato ring-spot virus
- ☞ Tomato spotted-wilt virus

The Future For Hydrangeas

Forcing of hydrangeas for Valentine's Day is already common for many producers, and the trend seems to be increasing.

Another change which may take place in the future is an increase in the number of cultivars of the florists' hydrangea (*Hydrangea macrophylla* subsp. *macrophylla* var. *macrophylla*) and hydrangea species being produced. An example of new cultivars would be 'Kasteln'. A few years ago, it was relatively unknown; now it is becoming a major cultivar for late-season forcing.

With regards to new species, look for 'Pia' (*Hydrangea* × *'Pia'*) in the next few years. This selection is very dwarf, seems to always flower pink, and is very winter hardy. Other possible new hydrangeas include the lacecap varieties (*Hydrangea macrophylla* subsp. *macrophylla* var. *normalis*) such as 'Libelle' (dragonfly), 'Taube' (dove), and 'maculata', which has variegated foliage. The lacecaps have a more open inflorescence than the florists' hydrangeas and are an exciting edition to the hydrangea fare.

Suggested Readings

Bailey, D.A. 1989. Hydrangea Production. Timber Press. Portland, Oregon. 91 pp.

Bailey, D.A. 1992. Hydrangeas, p. 365–383. In: R.A. Larson (ed.). Introduction to Floriculture, Second Edition. Academic Press. San Diego, California.

Shanks, J.B. 1991. Hydrangea, p. 588–601. In: V. Ball (ed.). The Ball Red Book, 15th Edition. Geo. J. Ball Publishing. W. Chicago, Illinois.