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 x 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...
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 yd³ into the substrate. Rotating mono-ammonium phosphate (11-53-0) 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.

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 1. Description of the most common hydrangea cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Sepal color description</th>
<th>Relative days to flower*</th>
<th>Inflorescence size/plant height</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Böttstein</td>
<td>Dark red</td>
<td>Not recommended</td>
<td>Medium/Short</td>
<td></td>
</tr>
<tr>
<td>Brestenburg</td>
<td>Not recommended</td>
<td>Medium blue</td>
<td>83</td>
<td>Medium/Medium</td>
</tr>
<tr>
<td>Enziandom</td>
<td>Light pink</td>
<td>Deep blue</td>
<td>92</td>
<td>Medium/Tall</td>
</tr>
<tr>
<td>Kasteln</td>
<td>Dark pink</td>
<td>Medium blue</td>
<td>95</td>
<td>Medium/Short</td>
</tr>
<tr>
<td>Kuhnert</td>
<td>Not recommended</td>
<td>Medium blue</td>
<td>95</td>
<td>Small/Medium</td>
</tr>
<tr>
<td>Mathilde Gütges</td>
<td>Not recommended</td>
<td>Light blue</td>
<td>95</td>
<td>Large/Medium</td>
</tr>
<tr>
<td>Merritt’s Supreme</td>
<td>Dark pink</td>
<td>Medium blue</td>
<td>88</td>
<td>Large/Medium</td>
</tr>
<tr>
<td>Red Star</td>
<td>Light red</td>
<td>Medium blue</td>
<td>95</td>
<td>Large/Medium</td>
</tr>
<tr>
<td>Rose Supreme</td>
<td>Light pink</td>
<td>Light blue</td>
<td>103</td>
<td>Very large/Very tall</td>
</tr>
<tr>
<td>Schenkenburg</td>
<td>Dark red</td>
<td>Not recommended</td>
<td>95</td>
<td>Medium/Medium</td>
</tr>
<tr>
<td>Sister Therese</td>
<td>White</td>
<td>Not recommended</td>
<td>95</td>
<td>Medium/Medium</td>
</tr>
<tr>
<td>Strafford</td>
<td>Dark pink</td>
<td>Not recommended</td>
<td>99</td>
<td>Large/Medium</td>
</tr>
<tr>
<td>Todi (Toddy)</td>
<td>Dark pink</td>
<td>Not recommended</td>
<td>88</td>
<td>Large/Medium</td>
</tr>
</tbody>
</table>

*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.

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

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Relative height</th>
<th>Response to B-Nine</th>
<th>Recommended rate of B-Nine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Böttstein</td>
<td>Short</td>
<td>Great</td>
<td>0–2500 ppm</td>
</tr>
<tr>
<td>Enziandom</td>
<td>Tall</td>
<td>Moderater</td>
<td>5000 ppm</td>
</tr>
<tr>
<td>Kasteln</td>
<td>Short</td>
<td>Great</td>
<td>0–2500 ppm</td>
</tr>
<tr>
<td>Mathilde Gütges</td>
<td>Medium</td>
<td>Moderate</td>
<td>2500 ppm</td>
</tr>
<tr>
<td>Merritt’s Supreme</td>
<td>Medium</td>
<td>Slight</td>
<td>2500–3500 ppm</td>
</tr>
<tr>
<td>Red Star</td>
<td>Medium</td>
<td>Very slight</td>
<td>5000 ppm</td>
</tr>
<tr>
<td>Rose Supreme</td>
<td>Very tall</td>
<td>Moderate</td>
<td>5000–7500 ppm</td>
</tr>
<tr>
<td>Schenkenburg</td>
<td>Moderate</td>
<td></td>
<td>2500 ppm</td>
</tr>
</tbody>
</table>
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

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**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.

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Night temperature/ day temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54/65 60/75 66/75</td>
</tr>
<tr>
<td>Days from start of forcing to bloom (salable color)</td>
<td>112 88 80</td>
</tr>
<tr>
<td>Days from start of forcing to pea-sized inflorescence (1/16” diameter bud)</td>
<td>43 32 28</td>
</tr>
<tr>
<td>Days from pea-sized bud to bloom</td>
<td>70 56 52</td>
</tr>
<tr>
<td>Days from nickel-sized inflorescence (1/16” diameter bud) to bloom</td>
<td>53 42 39</td>
</tr>
<tr>
<td>Days from silver dollar-sized inflorescence (1 1/2” diameter bud) to bloom</td>
<td>35 28 26</td>
</tr>
<tr>
<td>Days from first color (drop temperature to 54°F night/65°F day) to bloom</td>
<td>18 18 18</td>
</tr>
</tbody>
</table>
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, Phylllosticta 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*)

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**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

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**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**

