

The crux of the color change is that aluminum ions complex with the pigment delphinidin-3-monoglucoside in the sepals to produce the blue coloration. A positive correlation between intensity of blue and aluminum foliar concentration has been demonstrated. Growers try to develop antique shades, somewhere between the rich blues and pinks by combining lime in the medium and aluminum applications. These in-between colors of hydrangeas are given the cutesy name “blurples.” From my experiences, any pink-sepaled form, even the fickle ‘Preziosa’, can be blued and vice versa. Although various cultivars are often listed as pink or blue, I don’t totally believe it. Lacecaps and mopheads respond in a similar fashion. The white cultivars typically are not affected and maintain their color; however, ‘Mme Emile Mouillère’ has a pink or blue eye depending on aluminum availability. This is true for some of the other white mopheads and lacecaps.

Bailey (1989a) listed several mitigating influences on sepal color. Aluminum uptake is antagonized by phosphorus, reduced by ammonium nitrogen ($\text{NH}_4\text{-N}$), and favored by nitrate ($\text{NO}_3\text{-N}$). For pink sepals, maintain high levels of nitrogen and low levels of potassium (K) and aluminum (<15 ppm); at pH 6.0 to 6.5, aluminum is only marginally available. For blue sepals, maintain a pH of 5.0 to 5.5, low levels of phosphorus, moderate levels of nitrogen, and high levels of potassium, and provide an ample supply of aluminum (>100 ppm): drench plants during September with aluminum sulfate (2.4 ounces/gallon), twice, 14 days apart. Anyone serious about commercial greenhouse production of hydrangea should acquire a copy of Bailey’s book; it was geared to greenhouse potplant hydrangea production, but the principles apply to garden and nursery culture.

Pruning

Pruning is forever debated! Gardeners are told to remove the oldest stems, prune everything after flowering, and/or don’t do anything. The truth is touched by all these admonitions. To understand the best pruning technique, examine the flower buds. Typically, *Hydrangea macrophylla* flower

buds develop on old (mature) wood of the previous year and open in late spring and summer of the following year. Flower buds are formed at the terminals of the stems and, if not killed by cold, provide the show. However, additional flower buds are also present, often along the entire length of the stem. These lower buds also have fully developed floral primordia, but they simply do not open if the terminal flowers develop (they are regulated by a hormonal process called apical dominance). This means the terminal shoot, i.e., the bud before it breaks, controls the release (growth) of the buds below. If the top portion of the plant is killed, then these lower flower buds are released from this apical control. I know a Minnesotan gardener (Roger Sefelt, 1215 28th Ave. NE, Minneapolis, MN 55418-2927) who wraps the stems, covers with mulch, and flowers the common cultivars. The flowers are derived from the protected buds lower on the stems. Growers take advantage of the flower bud development along the length of the stem by pruning the upper 50 percent of the stems. The lower buds then develop shoots with flowers at their terminus resulting in a more compact plant for the customer (and easier shipping). This pruning takes place in January and February. Gardeners should learn to check for flower buds by examining the nodes along the stem. The large, $\frac{3}{8}$ - to $\frac{5}{8}$ -inch-long, plumpish, shiny green, red to brown structures often portend a great flower display. Also, a large bud will be evident at the end of the stem. If the vagaries of cold weather do not intercede, then the flowers will be spectacular. To maintain plant habit and structure, the larger stems may be removed on a three-year rotation, leaving the younger stems that carry the abundance of flower buds. This involves utilizing a pruning tool like long-handled loppers and making the cuts as close to the soil line as possible. I noticed this pruning approach was prevalent in England. In the United States, stems are often killed to the ground or at least partially injured and the large stems may not develop.

Gardeners often query about removing (pruning) old flowers (inflorescences) when they are raggedy and off-color (brown). My approach is to remove them as they become unpresentable. Simply make the pruning cut below the inflorescence. Often a pair of leaves subtends the inflorescence of *Hydrangea macrophylla*, *H. serrata*, and others. Typically, there are no viable

vegetative buds at this node. This means, even if left, no new shoots will develop, only further down on the stem. Be careful with hard pruning in August and beyond, for new growth may occur. These tender shoots may not cold harden sufficiently by frost and could be seriously injured.

A recent study (Conwell et al. 2002) determined the “best” time for pruning container-grown *Hydrangea macrophylla* to ensure flower buds and fully developed inflorescences for the following spring and summer sales period. The results offer quantifiable evidence for when to prune. To my knowledge, this is the first published account with actual counts and not the usual anecdotal evidence, i.e., the plant flowered, looked good, was floriferous, very pretty, and other innocuous commentary. The procedure and results follow:

Container-grown, 3-gallon, 20-inch-high ‘Nikko Blue’, ‘Blue Wave’, and ‘Hobella’ were pruned to one-half their length, 2 to 3 inches from the surface of the medium, or unpruned, monthly from May to September. Number of flowers and consumer quality index were assessed in early May of the following year.

Plants pruned to one-half and 2 to 3 inches produced more flowers on average than the unpruned controls, i.e., 18, 15, 14 flowers per plant, respectively.

August and September pruning treatments resulted in similar plant quality ratings among the three cultivars when evaluated in early May.

Plants pruned May through August produced the most flowers the following year. September pruning resulted in an average of 8 flowers per plant for each of the three cultivars.

Conclusions? Flower buds are formed the summer and fall prior to flowering, and pruning, even down to the crown, at 2 to 3 inches, does not eliminate all the flower buds. In our work at the UGA Hydrangea Shade Garden, we counted as many as 40 flower buds nestled in the lower 6 inches of the stems of a potential introduction called ‘Mini Penny’. The take-home lesson: as long as the flower buds are not totally eliminated by

cold, flowers will be expressed even when plants are severely pruned. The unpruned treatment resulted in fewer flowers per plant than either pruning treatment; this tells me that although flower buds were present lower on the stem, the phenomenon of apical dominance did not allow them to be released from dormancy (control). Except for terminal flower-bud-only cultivars like 'Aysha', it might make sense to tip prune the hydrangeas as the leaves emerge in spring. Many times the tips are dead and a general tidying-type pruning would serve two purposes: a more aesthetic plant and increased flowers.