

Hydrangeas: Breeding, Selection, and Marketing

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Hydrangeas, particularly *H. macrophylla*, have accelerated in popularity and numbers in the last decade, the impetus being Endless Summer[®], a remontant cultivar that injected excitement and hope into the genus. Since 2000, over 90 hydrangeas were patented with numerous European and Asian pot-plant cultivars sourced, renamed, and perhaps trademarked. Most are not worthy of a garden HOOT! Also, many are promoted as reblooming (remontant) to compete with the Endless Summer[®] brand. At [Plant Introductions, Inc.](#), we trial “new” introductions against the true rebloomers . . . Endless Summer[®], ‘David Ramsey’, ‘Oak Hill’, ‘Penny Mac’, ‘Decatur Blue’, etc. Reblooming data are included herein.

Certainly, *H. serrata* is worthy, but does not embody the floral potency of *H. macrophylla*. *Hydrangea paniculata* is more popular due to Limelight[™], ‘Vanilla Strawberry’, ‘Phantom’, ‘Silver Dollar’, Little Lime[™], ‘Bombshell’, and others. The proliferation of cultivars of this species has outdistanced *H. macrophylla*. *Hydrangea quercifolia* is perhaps the most difficult to commercially produce. The flowers, foliage, and bark provide multi-season appeal. *Hydrangea arborescens*, with ‘Annabelle’ still the best white mophead, is now joined by two pink mopheads, Invincibelle[™] Spirit and Bella Anna[™]. The latter two, although beautiful, have weak splaying stems.



Hydrangea macrophylla Endless Summer[®] & *H. paniculata*
in a Portland, Maine landscape October 2010



Hydrangea macrophylla in Trewithen Gardens,
Cornwall, England

Hydrangeas: Breeding, Selection, and Marketing

An encapsulated Hydrangea summary follows.

Why the rebirth?

- International recognition of name
- Martha Stewart—lifestyle plant (garden shrub, fresh and dried flowers)
- Books—Lawson-Hall, Van Gelderen, Church, Dirr, Mallets, Harrison (new book in 2012 from Amazon), Boebel (hydrangeas for the north; enlightening read)
- Endless Summer®—rebloomer, great marketing, released 2004, 18 million sold by close of 2011
- Hydrangea Society—international conferences in Ghent in 2007; various regional hydrangea societies have organized and offer speakers, tours, etc. International conference in Angiers, France, July, 2012.

Breeding and Introduction—Who's on First

- University of Georgia program, early 1990s; 'Chantilly Lace' was the first; 'Blushing Bride' and Twist-n-Shout™ are remontant
- USDA—Drs. Sandra Reed, retired, and Tim Rinehart: Science, not cultivar driven
- Plant Introductions, Inc. (PII)—remontancy; novel traits using little-known species
- Abundant introducers, minimal testing; cherry-picking largely pot-plant cultivars from Europe and Japan; promoting them as garden worthy in U.S.
- Brands everywhere: Endless Summer® (Bailey), Forever & Ever™, Cityline™, Edgy™, Everlasting™ (Plants Nouveau), Mystical™, Hovaria® (Kaleidoscope®), Japanese Lady Series (Halo™, Frau™, and Angel™), Let's Dance™ (Spring Meadow), Next Generation™ (Ball Ornamentals)

Point of Emphasis:

Ball Ornamentals, 2011, lists 8 “new” *H. macrophylla*: 4 *H. paniculata*, 1 *H. quercifolia*

Plants Nouveau, 2011: 1 *H. arborescens*, 10 *H. macrophylla*, and 1 *H. paniculata*

Can anyone articulate the best garden-worthy introductions?

Hydrangeas: Breeding, Selection, and Marketing

Hydrangea arborescens—Smooth Hydrangea

- Many new introductions. Great for high pH soils. Zones (3)4 to 8(9) adaptability. Native and found in most of the eastern United States.
- ‘Annabelle’—time-honored white mophead; still one of the best, stems slightly floppy, grown worldwide
- ‘Bounty’—mophead, strong stems, PII is breeding with this
- ‘Grandiflora’—the old lumpy mophead standard, largely superseded by ‘Annabelle’
- ‘Hayes Starburst’—double, beautiful floral character, floppy habit, need stronger stems
- Incrediball™—supposedly largest mophead; flowers, based on performance at PII, about the same size as ‘Annabelle’ and stems splaying. Performing better in North.
- ‘Mary Nell’—beautiful large lacecap with sepals interspersed among fertile flowers
- ‘Ryan Gainey’—appears to have darker green leaves; slightly smaller white mophead inflorescences, and stronger stems than ‘Grandiflora’
- White Dome™—minimalist lacecap, why waste garden space?
- Pinks—‘Eco Pink Puff’ (lc), ‘Wesser Falls’ (lc), ‘Chestatee’ (lc), ‘Pink Pincushion’ (lc), Bella Anna™ (mh), and Invincibelle Spirit™ (mh). Bella Anna™, from PII, has deeper pink mophead flowers, darker green leaves, and stronger stems than Invincibelle Spirit™. Both have stems that do not support the inflorescences. Breeding continues at PII to develop strong stems and rich pink mopheads.



Hydrangea arborescens 'Annabelle'



Hydrangea arborescens flowering in the wild
Note lack of showy sepals



Hydrangea arborescens Bella Anna™

Hydrangeas: Breeding, Selection, and Marketing

Hydrangea paniculata—Panicked Hydrangea

- 80 to 90 cultivars; too many; cluttered but still coming from Bailey's, Ball Ornamentals, Plants Nouveau, University of Georgia. More forgiving in gardens than *H. macrophylla*. The move to smaller, compact habits is opening new markets, i.e., containers, low groupings, and masses. Recent query from a Dutch grower about PII breeding noted his nursery produced 600,000/year.
- Limelight® is huge; enjoyed perhaps the best marketing; potential to 10' and greater
- Now smaller Bobo™ (2.5-3' by 3-4'), Bombshell™ (2.5 -3' by 3-4') ; Little Lime™ (3-5' by 3-5') is a smaller version of Limelight™; Little Lime™ flowers abundantly as a small plant and the stems are sufficiently strong. Have seen Bombshell™ in England and it flowers profusely.
- 'Dharuma' (1c) (earliest flowering) begets Quickfire™ (next to flower)
- 'Phantom' (no royalty)—large flower
- 'Silver Dollar' (no royalty) —one of the best in trials at PII
- 'Summer Snow'—stable cream-green leaf variegation, loses variegation in heat, substandard flower.
- Pinky Winky™ (white to pink), 'Vanille Fraise' ('Strawberries and Cream', white to strawberry-rose, full inflorescence); White Diamonds™ (UGA) (large white sepals, heat tolerant, dark green leaves, strong stems)
- 51 UGA selections (see middle photo below); evaluated seven years in field with Baby Lace™ selected for introduction; Baby Lace™ is 3 ½' high and wide with dark green leaves, strong stems, and full white inflorescences, sepals pink with maturity in cool climate.
- See www.rhs.org.uk for Plant Trials Bulletin with 47 *H. paniculata* cultivars, photos, and evaluation remarks.



Hydrangea paniculata 'Grandiflora'
in France



Hydrangea paniculata selections at
The University of Georgia
Note Baby Lace™ in lower center



Hydrangea paniculata White Diamonds™
A University of Georgia introduction

Hydrangeas: Breeding, Selection, and Marketing

Newer (~2005 forward) *H. paniculata* introductions (follies), certainly overwhelming and oversaturating for most gardeners and retailers, include:

Chantilly™ ('Chazam')	'Revival'
Everlasting™ Flame ('Bokkatorch', PP21,292)	'Rosy Morn'
'Garnet'	'Snow Mountain'
Great Star® (PP20,222)	'Southern Cross'
'Honeycomb' ('Revival', Ball)	'Sundae Fraise' (compact)
Magical Candle™ ('Bokraflame')	'Sweet Summer' ('Bokrathirteen', PP21,778)
Magical Fire™ ('Bokraplume')	Tickled Pink™
Magical Flame™ ('Bokratorch', PBR)	'Vanille Fraise' (renamed 'Vanilla Strawberry' in USA)
Mega Mindy™ ('Llvomindy')	'Waterfall'
'Moonlight'	'White Goliath'
'Mountain Fragrance'	'Wim's Red' (same as 'Fire and Ice', Ball)
Passionate™ ('Paszam') 'Pink Beauty' Ice', Ball)	'Yuan-Yang'
'Pink Jewel'	

***Hydrangea quercifolia*—Oakleaf Hydrangea**

Superb native for summer and fall foliage; flowers almost a bonus.

- Sandy Reed's compact selections include 'Munchkin' (3 by 4 ½' in 9 years) and 'Ruby Slippers' (3 ½' by 5' in 7 years); the latter with upright white inflorescences turning pink to rose and holding the color. A beautiful plant.
- Alabama seedlings from wild (~7)—'Snowflake', 'Sumatanga Star' ('Suma Tanga Star') ('Snowflake' and 'Snow Queen' about the best)
- PII—breeding for strong stems, upright full white flowers, disease-free foliage, red fall color, ease of container culture. Selection 20-09 embodies the previous traits and is in tissue culture. 20-09 is shown in left and middle photos.

Hydrangeas: Breeding, Selection, and Marketing



Hydrangea quercifolia
in flower



Hydrangea quercifolia
fall color



Hydrangea quercifolia
'Snow Flake'
maturing flower

Hydrangea serrata—Mountain Hydrangea

- Native to Japan, Korea (China?)
- Lack floral pizzazz compared to *H. macrophylla*, typically flower earlier, do not have floral staying power of *H. macrophylla*
- More cold hardy than *H. macrophylla*
- Yamamoto, 2000, listed hundreds of cultivars
- 'Preziosa' (hybrid with *H. macrophylla*), 'Blue Billow', 'Blue Deckle' (rebloom), 'Miranda' (rebloom), 'Tiara' (rebloom)
- Sun Frost™ (gold new growth) and Summer Frost™ (white new growth) are recent introductions. Neither has commercial legs.



Hydrangea serrata



Hydrangea serrata
'Blue Deckle'



Hydrangea serrata
'Kyosumi'

Hydrangeas: Breeding, Selection, and Marketing

***Hydrangea macrophylla*—Bigleaf Hydrangea**

- The Star! Cold is limiting factor; early fall and late spring freezes, midwinter lows
- Remontancy opened the floodgates
- Japan and China, largely maritime
- >1000 cultivars
- International collections—France (2), Belgium
- PII breeds with *Dichroa febrifuga*, *H. angustipetala*, *H. luteovenosa*, *H. scandens* to introduce novel characteristics

Best *Hydrangea macrophylla* cultivars in Georgia and PII trials

(evaluated more than 250 over the past 15 years throughout USA and Europe)

Historical Cultivars

'All Summer Beauty' (mh)
'Ami Pasquier' (mh)
'Blue Wave' (lc)
'Frillibet' (mh)
'Générale Vicomtesse de Vibraye' (mh)
'Lanarth White' (lc)
'Lilacina' (lc)
'Mme. Emile Mouillère' (mh)
'Mousseline' (mh)
'Nikko Blue' (mh)
'Veitchii' (lc)
'White Wave' (lc)

Remontant Cultivars

'Blushing Bride' (mh)
'David Ramsey' (mh)
'Decatur Blue' (mh)
Endless Summer® ('Bailmer') (mh)
'Mini Penny' (mh)
'Nantucket Blue' (mh)
'Oak Hill' (mh)
'Penny Mac' (mh)
Twist-n-Shout™ (lc)

Hydrangeas: Breeding, Selection, and Marketing



Hydrangea macrophylla

full sun exposure
Clayton, Georgia
Elevation 1925'



Hydrangea macrophylla

collection
Trelissick Garden
Cornwall, England



Hydrangea macrophylla

Midnight Duchess™

Remontant Comparisons: Currently many “new” introductions are marketed as reblooming. The comparative evaluation work at PII indicates that none have superseded the original Endless Summer®. For the gardener, tread carefully when purchasing these highly marketed hydrangeas.

Cultivars transplanted as liners to 3-gallon containers on April 1, 2011; all flower buds removed through June 1. Any new flowers/flower buds developed on new growth (i.e., remontant genetics). Flowers (color, sepals expanded) and flower buds (broccoli stage, green) recorded on August 13, 2011 and October 21, 2011. Latter presented because data represent totals. Three to 5 single plant reps for each cultivar.

Original Remontant Mopheads	Flowers/Flower Buds
'Blushing Bride'	3.2/0.8
'David Ramsey'	7.4/0.8
'Decatur Blue'	8.75/0.5
Endless Summer®	11.2/0.8
'Mini Penny'	4.4/2.6
'Nantucket Blue'	8.6/1.8
'Oak Hill'	9.3/1.3
'Penny Mac'	10.3/0.66
Let's Dance® Series	
Big Easy	0/0

Hydrangeas: Breeding, Selection, and Marketing

Moonlight	0/0
Starlight (lacecap)	0/0
Forever and Ever®	
Double Pink	0/0
Original	0/0
Peppermint	0/0

Role of Aluminum in red to blue color in sepals of *H. macrophylla* (also applies to *H. serrata*)

Al+++ is the key. Complexes with the anthocyanin, delphinidin-3-glucoside, to produce BLUE. All pink-sepaled cultivars turn blue in presence of sufficient aluminum. Superior research by Dr. Henry D. Schreiber, VMI, *Biometals* 24:1005-1015 (2011) details the role of Al+++ and quantifies concentrations for bluing cultivars.

The pH of the soil (medium) either solubizes Al+++ (low pH) or creates insoluble precipitates [Al(OH)₃] (high pH) that cannot be absorbed. Plants grown in bark, regardless of pH (low), do not turn blue because there is no (minimal) Al+++ in the substrate. Majority will be pink.

Aluminum (Al+++) concentration and sepal color ranges are detailed in Dr. Shreiber's paper.

Red: 0-50mg Al/g fresh weight

Purple: 10-100mg Al/g fresh weight

Blue: 40-500 mg Al/g fresh weight

Coloration and concentration: sepals could be red, purple, or blue with 50 mg Al/g fresh weight. Not absolute!

Why are certain cultivars more RED or BLUE than others? Color is correlated to concentration of pigment (delphinidin-3-glucoside) in the sepals. Following table from his research provides a classification for light, medium, deep, and very deep cultivars.

Anthocyanin content of sepals, expressed as µg delphinidin-3-glucoside per gram of fresh sepal, for various cultivars of *Hydrangea macrophylla*. Cultivars are classified according to the intensity of their coloration, independent of the actual color (whether red, blue, or purple).

Hydrangeas: Breeding, Selection, and Marketing



Hydrangea macrophylla

'Blaumelse'
with Aluminum



Hydrangea macrophylla

'Blaumelse'
without Aluminum

Class	Cultivars within Classification	Anthocyanin
Cold-hardy (light colored)	'Penny Mac', 'Nikko Blue', 'Dooley', Endless Summer®, 'David Ramsey', 'Générale Vicomtesse de Vibraye', 'All Summer Beauty', Forever & Ever®	80-120
Classic (medium colored)	'Bottstein', 'Blue Danube', 'Red Star', 'Blauer Zwerg', 'Mathilda Gütges', 'Tovelit'	140-190
Vivid (deep colored)	'Eisvogel', 'Alpengluhen', 'Hamburg', 'Pia', 'Masja', 'Enziandom'	230-270
Vibrant (very deep colored)	'Marechal Foch', 'Leuchtfeuer', 'Forever Pink', 'Glowing Embers', 'Kardinal', 'Monteforte Pearle'	300-700

Al+++ and bluing

Al+++ : delphinidin molar ratio (10:1) requires a sufficient excess of aluminum to achieve maximum bluing. Obviously, specific cultivars like 'Marechal Foch' require greater Al+++ sepal levels because of higher anthocyanin concentrations. A single shrub may have pink, mid-blue, purple, deeper blue inflorescences. These differences are most logically predicated on the level of Al+++ swamping the anthocyanin. If low, pinks; if high, blues; in-between the colors are variable.

Hydrangeas: Breeding, Selection, and Marketing

Bluing does not occur rapidly and in a garden setting may take several seasons. I have observed this with Twist-N-Shout™ in my daughter's garden. When the sepals are swamped with Al⁺⁺⁺, the formerly pink-rose-mauve color becomes almost periwinkle/gentian blue. Certainly, not an instantaneous chemical change.

***Hydrangea macrophylla* molecular advances (tim.rinehart@ars.usda.gov)**

- Mapping remontant, inflorescence type and powdery mildew genes
- 24,000 genes in leaves, stems, and flowers
- Identified gene involved in pollen tube growth; when knocked out plant is sterile and powdery mildew resistant
- Candidate genes (i.e. remontancy) used in transformation to make GMOs (genetically modified organisms)
- First applications of this technology to a woody ornamental
- Regulatory hurdles make the procedure expensive