

Section 5

Bougainvillea

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History

The genus *Bougainvillea* is in the family Nyctaginaceae and consists of about 14 species. It was named in the 1760s for Louis Antoine De Bougainville, a French navigator, by the French botanist Philibert Commerson. Most of the species are found in Brazil, Ecuador, and Peru. The majority of commercially-grown bougainvilleas are of the species *glabra*, *peruviana*, and *spectabilis* and their hybrids, such as *B. x buttiana*, (a hybrid of *B. glabra* with *B. peruviana*). The plants are shrubby to vining, with inflorescences of brilliantly-colored bracts enclosing small, tubular white or yellowish flowers. Their principal use has been in landscapes where they are trained over arbors, sheared into hedges, allowed to grow unhindered into barriers, and used to cover slopes. As gardeners adopted them, plants were managed into small trees, espaliers, and standards; placed in containers (Figure 5-1); and compressed into bonsai. A popular form for commercial glasshouse production involves training the plants onto hoops of various shapes.

New growth is required for inflorescence production, which occurs on short stem axes borne laterally in the axils of leaves. When conditions are unfavorable for the development of an inflorescence, the apex aborts and a thorn results. The call for a thornless bougainvillea, then, would mean a plant with few flowers.

A great interest in these plants began in India in the mid-1800s, and their popularity exploded in the 1920s with the arrival of a brilliant red, 'Scarlet Queen.' Bud sports from this cultivar led to a number of new cultivars and the introduction of variegated forms. The previously limited pink-purple-red bract assortment expanded to orange, deep pink, rose, and blends of these colors (Figure 5-2). The first *B. glabra* x *B. peruviana* hybrid was 'Partha' released in 1942 as the forerunner of the *B. x buttiana* complex. It was notable also for the changing colors as the bracts age and for the ease of rooting of its cuttings. In the late 1940s, the cultivar 'Mahatma Gandhi' sported to produce 'Mary Palmer,' which produces both white and magenta-pink bracts in the same inflorescence. In the 1960s, multi-bracted bougainvilleas were introduced from the Philippines. The first was a rhodamine-purple sport of 'Mrs. Butt,' and it was followed by other

sports of pumpkin-orange, pink, white, and magenta-purple. During the '60s and '70s, new cultivars emerged from open pollinated selections from East Africa as well as from the application of scientific efforts (induction of tetraploidy to overcome sterility and the use of gamma- and x-rays to induce mutants) at the National Botanical Research Institute of Lucknow, India, and the Indian Institute of Horticultural Research of Bangalore, India. The Philippines, and more recently, Thailand, have also been the sources for new bougainvilleas, while seed from Kenya was imported into Hawaii and produced many, mostly-unrecognized varieties.

Production of bougainvilleas in pots for the home developed in Denmark, Holland, and Germany as

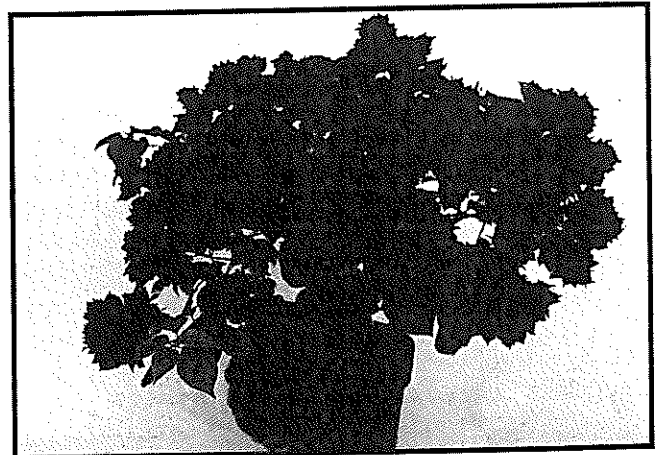


Figure 5-1. Bougainvillea can produce a very attractive potted plant.



Figure 5-2. Bougainvillea bracts come in a range of colors. Also note the variegated foliage exhibited by some cultivars.

growers experimented with plants brought back by collectors. Grafted plants bearing several color forms are a speciality in Thailand. Bougainvillea is also a popular plant with bonsai collectors.

Cultivars

A central registration authority for bougainvillea exists at the Indian Agricultural Research Institute in New Delhi, India. Despite attempts to follow the nomenclatural code for cultivated plants, cultivar names are often confused, changed from locale to locale, and misspelled. Only a few cultivar names have been consistently applied to selections with very recognizable characteristics. The 4th edition of *Complete Gardening In India* (Gopalswamiengar, 1991) lists more than 100 cultivars suitable for pot growing and another 200 or so for other landscape uses. The *Bougainvillea Cultivars Cross Reference Directory* (Lucas, 1994) describes 99 cultivars (and their synonyms) grown in the United States. The most available reference is *The Bougainvillea Growers Handbook* (Iredell, 1990), which targets the hobbyist grower.

Cultivars with *B. spectabilis* heritage tend to have a more seasonal blooming pattern than those with *B. glabra* or *B. x buttiana* backgrounds. The latter are better adapted to pot culture. Bract sizes range from less than 0.5 inch to 2 inches in length, and they vary in shape from rounded to narrow and pointed. The bracts abscise as they age, except in the multi-bracted forms, where they are persistent.

Variegated foliage. Although variegated cultivars have been available since the 1930s, their use as oramentals developed following the introduction of 'Rao,' a bud sport of 'Mrs. Butt.' Variegation patterns include yellow, cream, or white central patches, mottling, streaks, spots and dots, and marginal variegation. A recent, popular form includes pink or rose, yellow, and various shades of green variegation. Some variegated selections also sport distorted leaves and reduced bracts.

Current Marketing

In the warm regions of the United States, bougainvillea are mostly marketed in 1-gallon or larger containers for landscape and accent plant use. In Europe, the plants are heavily pruned or trained on hoops and sold in 6- to 8-inch pots. Growers have noticed that bougainvillea just past the cutting stage can be flowered in 3- to 4-inch pots, and this may offer a potential for the mass markets. Bougainvillea hanging baskets (8- to 10-inch) are popular items in Southern garden centers. Bougainvillea are also grown and marketed as standards and, to a limited extent, as bonsai.

Small plants are set into summer landscapes in the North as bedding plants, a practice common with conservatories that have facilities to overwinter the plants as cold weather sets in.

Crop Culture

Given the diverse background and assortment of bougainvillea cultivars, it is obvious that a single production strategy may not apply to all cultivars. Many growers opt to purchase started, young plants from propagators located in warmer areas rather than spend the time to propagate from cuttings.

One to three cuttings are used in 4- to 4.5-inch pots and three to five cuttings in 5- to 5.5-inch pots in European fast-culture programs. This program uses young terminal cuttings followed by two to three pinches to induce branching.

In a slow-culture system with multiple pinching and shearing operations to shape the plant and increase branches, one to three plants are used in containers up to 10 inches. Slow-culture systems include the winter months, and the plants are forced for spring bloom.

Because bougainvillea are sensitive to overwatering, small plants are not usually planted into large pots, but are shifted up as they develop.

Propagation

Seed propagation is not an option, and cutting propagation is most common. Although softwood terminals can be rooted, most propagators prefer maturing green wood, and matured intermediate wood stem pieces can be used as well. Cutting diameters of 0.1 to 0.2 inch give the best results. Stem piece cuttings should have three to five nodes. Leaves may be left on the cutting during rooting, but they will generally abscise midway through. Cuttings may be direct-rooted singly in small pots or Jiffy-7s, or two to three cuttings may be rooted together in 5- to 6-inch pots. Mother plants should be managed by frequent pruning to produce the most rapid-rooting cuttings. There is considerable varietal difference in rooting ability.

In the propagation house, an air temperature of 75°F is desirable with a bottom heat of 75 to 82°F. Intermittent mist and fog are commonly used to prevent desiccation during rooting. The propagation medium should not be too heavy because the young root system is brittle, and a heavy medium tends to fall apart during potting, taking the root system with it. Peat and perlite (1:1 volume:volume) is

satisfactory, although peat and coarse sand are used when sufficient time is allowed to develop a sizable root system. Foam block propagation units are also widely used. Coir as a rooting medium has produced good results in Hawaii.

Rooting hormones speed rooting, which can take four to six weeks. IBA (3-indolebutyric acid) concentrations of 2,000 to 4,000 ppm are used for most cultivars, but even higher concentrations are used for difficult-to-root types. Softwood terminals of easy-to-root cultivars do not require a rooting hormone. There is no reference that identifies the ease of rooting for different bougainvillea cultivars; the best guide is experience and the ability to observe what cultivars are the most widely produced.

Media

Although media such as 1:1 peat-perlite are satisfactory, they tend to be lightweight when dry. The pots become top-heavy with a well-grown plant. A balance must be maintained between the need for weight and too much water retention. Some growers use sand or a portion of soil to add weight. Plants grown in media that holds too much water suffer from poor root systems and are less prone to flower.

The media pH should be 5.5 to 6.0. At pH values above 6.5, iron uptake is limited and chlorosis is a problem. At acid pH values, an excess of available manganese may induce iron deficiency symptoms.

Irrigation And Water Quality Considerations

In the landscape, bougainvillea tolerate slightly brackish water but develop chlorotic leaf margins. In pot cultivation, liquid feed use ranges from daily with low nutrient concentrations to weekly or bi-weekly, implying that high salt levels in the media are undesirable. "Good quality" water is preferred.

Bougainvillea tolerate drying down and should be grown on the "dry side." They are sensitive to overwatering, but should not be allowed to dry out completely either. On an automatic watering system with daily irrigation, good drainage is necessary. Growth in a wet regime tends to be soft and vegetative.

Fertility Regimes

Liners are potted into media with organic fertilizer amendments or controlled-release fertilizers (CRF). A high phosphate starter solution also is recommended. Top dressing with CRF is necessary during long-term culture. Fertilizer ratios of 1:1:1 and

2:1:2 are most frequently used. Liquid feed for container-grown plants should provide 150 to 200 ppm each of N and K. High levels of nitrogen encourage vegetative growth, while additions of potassium at high nitrogen levels reportedly improve flowering. High nitrogen, coupled with short daylengths also is reported to improve flowering. At low levels of nutrition, extra potassium has little effect. Occasional addition of magnesium at 50 ppm from magnesium sulfate is recommended. Applications of soluble minor elements prevent chlorosis and are thought by bougainvillea specialists to improve flowering. In a fast-cropping program, inclusion of minor elements in the potting media is probably a better choice.

Growing Temperatures

B. glabra types tolerate somewhat cooler conditions (58 to 64°F) than do *B. spectabilis* (64 to 68°F). European production strategies include allowing the plants to drop their leaves in winter and go into a semi-dormancy with night temperatures of 43 to 50°F for *B. glabra* and 50 to 58°F for *B. spectabilis*, followed by gradual warming as light levels increase in the spring.

In landscape situations, bougainvillea tolerate temperatures over 100°F, but container-grown plants dehydrate quickly at such temperatures. Bougainvillea plants die back if the top growth is subjected to short exposures to frost, but established plants will resprout from the basal stem after dead top growth is removed.

DIF Management Strategies

No research has been reported in this area with bougainvillea. The sensitivity of bougainvillea to cool temperatures suggests that a marked effect would be possible.

Lighting/Photoperiod Response

Bougainvillea requires high light intensities for good flowering. Producers in Hawaii and Florida use no shade. The high-light requirement, however, leads to leaf drop in low-light interior environments. Care tags advising that the plants be placed in bright light or near a window should be included in marketing.

Short daylengths favor flower initiation but are not required. Controlled flowering may be achieved with 8- to 11-hour daylengths as long as the daytime light intensity is high and air temperatures are above 58°F (64°F for some cultivars). In Europe, most production is geared toward spring flowering,

with little winter production because of reduced light intensities and cool nights. Inflorescences develop in 7 to 10 weeks after the start of short days. Varietal differences exist in responsiveness and time to flower, but no published guide exists for the grower.

Under long days, drought stress seems to stimulate flowering in landscape plants. Management of greenhouse-grown plants to induce flowering by applying drought stress requires considerable skill.

Pinching

Flowers are borne on new growth; thus pinching and pruning to induce new growth is necessary. *B. glabra* and *B. x buttiana* hybrids flower well in containers, but some of the *B. spectabilis* cultivars are more difficult to bring into flower following pruning.

In the fast-cropping production systems, liners are pinched upon potting and again four to six weeks later. A third pinch may be used if the plants are too vigorous.

Growth Regulator Strategies

Growth regulators are used in four areas: rooting of cuttings, induction of lateral shoots, retardation of growth, and preventing bract abscission.

Branch-inducing compounds such as benzyladenine (BA) and dikegulac sodium have been used successfully on bougainvillea. Two applications of BA (50 to 100 ppm) are made to increase lateral branch production, one at 24 hours after the first pinch and the second at 24 hours after the second pinch. Stock plant management for cutting production may be improved with BA. Dikegulac sodium has been reported to improve flower production, with a weaker effect on branching when applied in lieu of the second pinch. The commercial formulation Atrimmec (18.5% active ingredient) has been used at the rate of 8 ml/liter (1 oz/gallon).

All of the major growth retardants have been evaluated on bougainvillea for effects on flowering and compactness. Europeans have used Cycocel (chlormequat) for more than 20 years despite some chlorosis problems, while one of the first U.S. papers outlining a cultural method for potted bougainvillea (Hackett, et al, 1972), recommended its use as a soil drench of 0.3 to 0.5 grams per pot as the axillary buds swelled following the first pinch. A-Rest (ancymidol) and Bonzi (paclobutrazol) are also effective. However, growth retardant use

seems unnecessary if plants are grown in high light and on the dry side.

A problem of premature bract abscission was solved through the use of the sodium salt of naphthaleneacetic acid (NAA) as a spray or dip at the rate of 10 to 30 ppm. At the high rate, NAA may promote abscission of immature bracts.

Pest Problems

Insect pests include various caterpillars, aphids, soft scale, whitefly, and the bougainvillea beetle (*Amphericus cornatus* Pallas). Mites can be a problem in hot, dry conditions.

Leafspot diseases caused by bacteria (*Pseudomonas stizilobii*, *P. andropogonis*) and fungi (*Cercosporidium bougainvillae*, *Colletotrichum dematium bougainvillae*, and *Gladosporium arthrinoideis*) are prevalent in landscapes. Cuttings collected from such sources bear watching. Various broad-spectrum fungicides may be used for control. An aphid-transmitted cucumber mosaic virus produces roughened leaves, some with a chlorotic pattern. Plants suspected of harboring this virus should be destroyed. Root rot pathogens such as *Rhizoctonia* and *Pythium* may attack cuttings during propagation. *Botrytis* can be a problem in humid glasshouse culture where it attacks young leaves and flowers.

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Sample bougainvillea fast crop production schedule.

Temperature	68-77°F	D/N 64/59°F (B. glabra, B. Xbuttiana) 68/64°F (B. spectabilia)	
Photoperiod	Long Days	Short Days begin after	
Growth Regulator	IBA for rooting	BA @ 1st pinch	Cycocel drench Atrimmec instead of 2nd pinch for some varieties NAA to prevent bract abscission
Operation	Propagate terminal greenwood cutting	Pot	1st pinch
			Flower
			2nd pinch
			Flower
			3rd pinch (if needed)
			Flower
Time	4 to 6 weeks	10 days	4 weeks
			4 weeks
			8 to 10 weeks

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