

10). *Sansevieria suffruticosa*: This sansevieria comes from Kenya. It has a moderate growth rate and remains open.

We believe that among these plants you will find some valuable additions to the list of those you already grow.

TEN OUTSTANDING PERENNIALS

DAAN KNEPPERS

10319 Pierce Drive
Silver Springs, Maryland 20901

1). *Paeonia*, family Paeoniaceae, peony:

Peonies are rated among the most beautiful of all perennials, both in plant and flower. They are easy to grow and long-lived. The peony is hardy in every state of the U.S. and in Canada. Disease and insects rarely bother them if the following suggestions are followed. They make excellent cut flowers and give beautiful landscape effects.

They do best in a sunny well-drained location. Plant a peony with the top of the eyes pointing up, eyes not over 2 in. below soil level. Plant in 1 gal. or 2 gal. container. The planting time is in the fall or early spring.

Fertilize peonies with a slow-release fertilizer (low in nitrogen), after the first roots are established, in the spring or early fall.

The stembuds, or "eyes" as they are called, are formed soon after blooming season at the base of the stems. They are the beginning of next year's growth.

The blooming season begins in early spring, about the time the tulips open, and it ends 6 to 8 weeks later. As soon as the foliage turns brown in late summer, leaves may be cut off to soil level.

Spraying plants against *Botrytis*. Spray the plants against *Botrytis* as soon as new shoots appear. Spray the second time when the plant is half grown, and spray again just before they bloom. Use Captan or Benlate.

Why do peonies not bloom? Plants may be too young and immature or planted too deep. Buds may have been killed by late frost or by *Botrytis*. In this case they turn black and die. Too much shade makes plants leafy and tall with little bloom.

Peonies are sold in the trade by the number of eyes: 2 to 3 eyes/division, 3 to 5 eyes/division. Following is a short list of outstanding cultivars.

Paeonia officinalis 'Rubra Plena': Blooms approximately 2 weeks earlier than the regular hybrids. It comes in double red, white, and pink, grows 24 in. high with approximately 4-in. flowers.

Paeonia 'Krinkled White': Blooms late to midseason. It is a large single flower with great, broad pure white petals and strong stems.

Paeonia 'Monsieur Jules Elie': Double, early pink, large blooms, very free-flowering, light green foliage. One of the most popular peonies.

Paeonia 'Festiva Maxima': Double, white, early flowering, fairly fragrant; flower has some crimson flakes on a few central petals. Large dark-green foliage, very old but still a good cultivar.

Other good peonies are: 'Karl Rosenfield', red; 'Shirley Temple', white; 'Red Charm', red; 'Mother's Choice', white.

Information is from the American Peony Society.

2). *Phlox paniculata* [syn. *Phlox decussata*], family Polemoniaceae. Border or garden phlox.

The spectacular show produced by garden phlox is equalled by no other summer-blooming perennial. The 5-in. diameter flower heads are very fragrant and are long lasting.

Phlox are very adaptable and respond to good cultivation. They do best in rich porous soil and respond to a moderate to heavy fertilizing schedule. They also need protection from wind, a period of winter dormancy, and most important of all, plenty of water during the summer months while they are blooming. They grow in full sun or light shade.

Phlox is not at all a maintenance-free perennial. They are particularly susceptible to powdery mildew, especially toward the end of the season. A spray program including Benlate, Acti-dione P.M., sulfur, and Bayleton can help. Spray plants every 2 to 3 weeks. Avoid watering foliage, which encourages the fungus mildew. To encourage flowering, remove the main flower head when it fades. If you do not do this, eventually the seedlings will take over the main plant. The seedlings will not come true to type.

Colors of the hybrid phlox range from pure white through every shade of pink to red and from pale blue to deep purple. Many cultivars have bright central eyes of contrasting colors.

Border phlox is propagated by root cuttings taken in the fall or stem cuttings taken in the summer. Divide clumps every 3 to 4 years. Phlox are available in the trade as 4- to 6-eye divisions.

Some good cultivars include: Bright Eyes, white with pink eye; Mount Fujiyama, large white heads; Spitfire, salmon red; Starfire, red; Orange Perfection, orange; Blue Moon, dark purple.

3). *Astilbe*, family Saxifragaceae. Sometimes called false spiraea:

Astilbe do best under light shade and with ample moisture. They are very hardy, long-lived, low in maintenance, with beautiful spikes of flowers and very attractive foliage. They form woody crowns and can produce massive growth in good moist soil. In hot and dry regions the foliage will easily burn and turn brown. The ferny foliage of the dark and red-flowering *astilbe* is dark or red-tinted, others are green. *Astilbe* is a heavy feeder. It needs a very rich, moist soil and exhausts the soil very quickly. Fertilize with a quick-release fertilizer, 5-10-5. When dormant, the roots do not tolerate dry or soggy or alkaline soil. *Astilbe* is propagated by root division, mostly in 2-to-5-eye divisions.

They are also very good for cut flowers or dried flowers. You can force the plants in the greenhouse, cut the flowers, then plant outside and treat as a perennial.

An easy-to-grow cultivar is *Astilbe chinensis* 'Pumila'. This plant takes more sun and less moisture than any other *astilbe*. The foliage is creeping. It makes an excellent edging plant. Another nice plant is *Astilbe thunbergi* 'Straussenfeder'. This has pendulous flowers — a very different *astilbe*. Other good cultivars are:

Astilbe × *arendsii* 'Fanal', red; *A. × arendsii* 'Peach Blossom', salmon pink; *A. × arendsii* 'Red Sentinel', deep red; *Astilbe japonica* 'Europa', clear pink; *A. japonica* 'Deutschland', white; *Astilbe taquetii* 'Superba', purple rose, and fairly heat- and drought-resistant.

4). *Liatris*, family Compositae; gay-feather or blazing star:

This is the only spike-flowering perennial to my knowledge that flowers from the top to the bottom. It has to be grown in full sun and does best in a sandy soil. The brightly-colored purple to pink or white small flowers gather around the slender stem.

The fleshy corm-like roots should be divided every 3 years, otherwise they get too crowded. *Liatris spicata* can easily be grown from seed and is one of the most adaptable species and fairly drought-resistant. There is also a white form, *L. spicata* 'Alba'.

Liatris is very good as a fresh cut flower, dried flower, or grown in a container as a pot plant. For better show, plant

more corms per pot. The flowering time of *L. spicata* is mid-summer.

L. spicata 'Kobalt' is compact and blooms 2 to 3 weeks earlier. This dark purple, 2 foot-high plant is only grown by division. It does not come true from seed.

5). *Iris pumila*, family Iridaceae. Dwarf bearded iris:

This compact dwarf flowers at daffodil time and is the first bearded iris to bloom. The dwarf bearded iris is 8 to 16 in. high (flowering height). These plants have unbranched flower stalks.

Iris pumila is very useful as an edging plant or in front of taller and later flowering irises. It is also small enough to use in rockgardens. *I. pumila* is very vigorous and extremely hardy, quickly growing to large clumps, covered with lots of blooms.

Iris pumila grows best in full sun, in well drained soil, which is not too acid. Application of lime is suggested to make a sweeter soil. It is propagated by rhizome division done in July or August. The rhizomes of the dwarf bearded iris should only be half covered with soil when planted. The sun should shine on the top of the rhizomes.

Some good cultivars are: Flaming Gold, yellow; Banburry Ruffles, dark blue; Lenna M., apricot; Cherry Garden, purple; Ritz, yellow with brown edge.

6). *Hosta*, family Liliaceae. Plantain lily:

Hosta is a very hardy and easy-to-grow perennial. Plants are mound-shaped and feature large attractive leaves from deep blue to light green. A wide range of variegated leaf forms have come on the market in recent years.

Hostas do best in moist rich soil and light shade. A hosta can stand wet soil when in growth, but not when dormant.

Hostas are rated among the most beautiful perennials for shade growing. Leaves can be lance-shaped, rounded or somewhere in between and range from less than an inch to more than a foot across. The texture of the leaf can be smooth, ribbed, waved, flat or twisted. Leaf colors include light green, dark green, yellow and grayish or blueish green. Some plants have leaves that are edged or have various patterns in white, cream or yellow.

The height of hosta ranges from 3 in. to over 3 ft., not including flowers. The flowering height can vary from 10 in. to as tall as 6 ft. The flowering season is between early June and October. Few cultivars are fragrant. Flowers are of secondary importance. Hostas are grown in partial to almost full shade.

They can withstand more sun if they have enough moisture, but otherwise they burn. Hostas are mostly grown in one-qt. or one-gal. containers or are field grown. They are usually pest-free. The worst enemies are slugs and snails; the larger the leaf the more apparent the damage. A good remedy is to spray a liquid slug and snail killer on the leaves, which is more effective than pellets or powders scattered on the ground. Treatment must start early.

Propagating is done by root division and tissue culture. Tissue culture can be a way to provide a quick and good supply of the rare and new cultivars.

The following cultivars are some we feel are outstanding: *Hosta sieboldiana* 'Francis Williams': the number one rated hosta for three years by a popularity poll of the American Hosta Society. The interior leaf of this beautiful plant is blue-green with a gold edge. Flowers are white.

Hosta sieboldiana 'Elegance': This is a gigantic, excellent blue hosta. The clump is 2 to 4 ft. tall and as much as 4 to 5 ft. across at maturity. Attractive white flowers rise just above the foliage.

Hosta 'Krossa Regal': The leaves are blue-grey. The clump is vase-shaped. Flowers are soft orchid on stalks up to 6 ft. high. It is an excellent plant and good grower.

Other good hostas include: 'Royal Standard', shiny green leaf with white fragrant flowers; *Hosta lancifolia* 'Kabitan', small variegated border plant; *Hosta* 'Tokudama', true blue, good medium-size plant; *Hosta undulata* 'Albo Marginata', an old but still good variegated cultivar.

7). *Dicentra spectabilis*, family Fumariaceae. Old-fashioned bleeding heart:

An old-fashioned plant that no garden should be without. It has pendulous arches of clear pink, tiny hearts. The bleeding heart is taller and wider than the other species of *Dicentra*. Foliage is very pretty but less finely divided.

Dicentras have deep, fleshy roots and need a loose, moist soil. Grow in partial shade. Foliage usually dies back in the early summer. After the *dicentra* flowers for the first time, it can be cut back to 2 to 4 in. above soil level and will flower again.

Dicentra spectabilis can be propagated by division, by root cuttings taken in early spring, or by stem cutting in spring or early summer. White-flowering *Dicentra spectabilis* Alba is slightly less robust than the pink variety.

8). *Hemerocallis*, family Liliaceae. Daylily:

Daylilies are among the most adaptable and satisfactory perennials. They withstand heat and dry weather better than most garden flowers and can be grown in almost all parts of North America. These plants grow with minimum care in full sun or light shade in almost any soil. Daylilies produce long, narrow leaves and showy large flowers in a very wide range of colors. Depending on the cultivar, the blooming time ranges from early spring until frost. Each plant bears many flowers on branching stems. The individual flower lasts only one day; however, they follow each other quickly, and some cultivars have long blooming times. The flowers are carried on strong 1-to-4 ft. stems. Flower sizes vary from 2 to over 6 in. Some cultivars have a very heavy substance, so they can withstand the hot, dry, sunny days. Some cultivars can have as many as 30 flowers per stem and as many as 20 stems or more on a mature plant. Spent flowers should be picked regularly to encourage future flowering. Every year there are more than 1000 new hybrids registered in every color and height.

There are dormant and evergreen cultivars. The dormant ones are best for the north as the evergreens have a very limited hardiness. They are excellent for the deep South and southern California.

Daylilies can be divided in fall or spring and are sold mostly in one-eye divisions. They are also successfully propagated through tissue culture. In the nursery a daylily is best grown in one-gal. containers. When roots are established, add a slow-release fertilizer and grow in full sun to partial shade.

There are hybrids that flower in spring, in early or late summer or in the fall. There are now cultivars that will re-bloom and flower almost from late spring until frost. Most daylilies are 2½ to 3 ft. tall when in flower, but there is an increasing range of dwarf plants and miniature flowers in all kinds of colors.

Good cultivars include: 'Mary Todd', early ruffled yellow; 'Lusly Leland', red; 'Stella D' Oro', 11 inches, fragrant, golden yellow; this excellent daylily blooms from June until almost frost. 'New England Night', very dark red; 'Just Watch', yellow; 'Asstelot' almost white; 'Anna Warner', pink; 'Butter Cup Parade', soft yellow.

9). *Iris kaempferi*, family Iridaceae. Japanese iris:

Japanese iris grows 3 to 4 ft tall in full sun or partial shade. Japanese iris have huge flat-topped blooms in colors of pure white, yellow, clear pink, every shade of lavender, purple, blue and bicolor. Some hybrids bear flowers as big as 1 foot across, but most plants have 6 to 9 in. blooms. They flower approximately 2 weeks later than standard tall-bearded

iris.

When Japanese iris is in growth, the soil should be kept constantly moist. In the winter they should have a much drier soil. They will do best in humus-rich soil, free of lime, with a pH of 5.5 to 6. Add sulfur, if necessary, to make the soil more acid.

They are propagated by root division in early fall or spring and are divided into two- to three-eye plants. Some good named cultivars are: Beni Botan, maroon purple; Mura-Komo, purple/white; Aichi-No-Kagayaki, yellow; Pink Lady, pink; Agogakujyo, deep purple; Haku Botan, pure white.

10). *Lilium*, family Liliaceae:

In my opinion this plant is very underrated for garden use and for a pot plant in the greenhouse, to bring in bloom different times of the year.

Lilies grow from bulbs, which are built up by scales. These scales are connected at the bottom. Lily bulbs are never dormant. They should be stored in a very humid, cool place to insure a good bud count and should never dry out.

The lily makes one stem, on which all the foliage grows. On top of the stem are the flowers. Each flower will last three to four days. They flower only once per year. Lilies should be grown in a moist, rich well-drained soil, in full sun.

The most common types of lilies listed according to blooming time are hybrid lilies, tiger lilies, trumpet lilies, oriental lilies and rubrum lilies. By planting these different types at one time, you will have flowers from June till September.

The hybrids are the largest group. This plant comes in almost all colors. Rosita, pink; Sterling Star, white; Aristocrat, orange; Corina, red; other colors are yellow, salmon, apricot and some newer cultivars in bicolor.

A lily grows on stem roots. It is important to plant a lily about 4 in. deep because the plant gets most of its food through absorption by the stem roots. This way the plant is healthier, has a better appearance, and will have a better bud count. The warmer the bulb temperature, the lower the bud count. A lily is an excellent perennial for garden use. It is hardy, easy to maintain, and gets more beautiful every year. Lilies also make good cut flowers.

Another group of lilies that deserves some extra attention, is the oriental lily. This is the most beautiful flower you will ever see. Some cultivars are very fragrant and come in rich pink lavender, and now also pure white colors. This is the Cadillac of all lilies!

Lilies are propagated by the stem bulbs which grow above the original bulb. Another way is by scaling the bulb. Give the scales a heat and cooling treatment, plant them, and grow for two years in the field. By then the bulb will be full size. This way stock can be built up rapidly. The newest cultivars are propagated by tissue culture. Commercial growers in the U.S. generally plant lilies in 1 gal. or in 6 in. containers. Plant 3 bulbs per pot, because this will give more show, and they will have a much longer shelf life.

ACCLIMATION AND WINTER PROTECTION OF CONTAINER-GROWN NURSERY CROPS

ROBERT D. WRIGHT

*Department of Horticulture
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061*

Acclimation and freeze tolerance of woody plants was addressed at the meeting of the Southern Region, IPPS in 1977 by this author and published in the Proceedings (9). In that paper the mechanisms whereby plants acclimate to cold temperatures and survive freezing temperature and desiccation injury were discussed. In the present paper an attempt will be made to build upon that information by explaining a new model for plant cold acclimation as it relates to winter storage, with emphasis on container production.

A physiological model called "Degree Growth Stage Model" ($^{\circ}\text{GS}$) has been proposed by Fuchigami *et al.* to describe the annual growth and hardiness of woody plants (3). Plants go from 0°GS to 360°GS in one calendar year (Figures 1 and 2). The $^{\circ}\text{GS}$ is not related to days in the year but to the physiological condition of the plant. For example, 180°GS may coincide with leaf fall may be October 1 in northern Ohio but October 15 in northern Alabama, depending upon the species in question. Another important point about plant development and responses to the environment is that plants are active physiologically even in the winter. Thus a proper understanding of these physiological events will assist the grower in protecting plants from winter injury.

Spring bud break starts at 0°GS and proceeds with rapid growth. During this time plants do not have the capacity to acclimate to freezing temperatures. The rapid growth phase is followed by a period where shoot growth slows and ultimately stops in response to decreasing photoperiod and warm tem-