

A Comparative Study of *Phlox paniculata* Cultivars

Richard G. Hawke, Plant Evaluation Manager



Mark Rudy

Phlox paniculata 'Shortwood'

Garden phlox, a staple of summer gardens since colonial times, are some of the most recognizable and popular perennials today. Their telltale magenta flowers enliven native landscapes for many weeks from summer to fall, while a myriad of cultivars in a rainbow of colors grace gardens everywhere. They owe their prodigious nature as much to the oversized flower trusses that crown tall stems as to the vivid pinks, purples, reds, and oranges of the flowers. Despite their well-known susceptibility to powdery mildew, garden phlox remain a perennial favorite prized for their dramatic, long-blooming floral show.

Phlox paniculata, garden or summer phlox, is one of 60 or so species of *Phlox* native to North America and is in the phlox family (Polemoniaceae), which includes the namesake *Polemonium*, or Jacob's ladder. Phlox is derived from the Greek word for flame, and so named for the brilliantly colored flowers. The specific epithet *paniculata* refers to the rounded to pyramidal panicles in which the individual blossoms are held. *Phlox paniculata* is native to the eastern

United States, from New York to Georgia, and west to Illinois and Arkansas. It has been in cultivation in Europe since the 1800s and many of the early cultivars originated in England and Germany. *Phlox maculata*, early or meadow phlox, is a native of the eastern United States, too. While similar in habit to garden phlox, its flowers are borne in elongated cylindrical clusters earlier in the summer. The species name reflects its purple-maculated or spotted stems. *Phlox xarensii*, a hybrid between *P. divaricata* (blue phlox) and *P. paniculata*, boasts greater mildew resistance than garden phlox. *Phlox paniculata*, *P. maculata*, and *P. xarensii* are collectively referred to as border phlox.

Flowers are without a doubt the main ornamental attribute of the border phlox. A pavonine palette of flower colors is available including shades of pink, salmon, orange, red, purple, lavender, blue, and white. While the magenta-pink flowers of wild *Phlox paniculata* are unmistakable, modern cultivars offer a variety of distinctive colors such as voluptuous cherry red ('Miss

Mary'), whimsical pink and white ('Peppermint Twist'), and delicate pink and yellow ('Sherbert Cocktail'). Each flower is composed of a long corolla tube and five petal lobes. The individual blossoms are grouped in many-flowered domed to elongated panicles at the ends of the stems and in the upper leaf axils. Flower size varies from ½ inch to almost 2 inches wide, whereas the panicles typically range from 4 to 6 inches tall and 6 to 8 inches wide. Flowers are fragrant, although the degree of fragrance is variable among cultivars. Flowering occurs from early summer to early autumn, with *P. maculata* and *P. xarensii* typically blooming earlier than *P. paniculata*.

Border phlox grow best in moist, well-drained soils in full sun to light shade. Despite being hardy and adaptable to a wide range of geographic regions in USDA Zones 4–8, border phlox perform best where summer nights are cool. Deadheading is recommended to promote continued bloom and prevent seedlings, which are not true to type. While border phlox are generally easy to grow, a number of disease and pest

issues can be troubling. High humidity and warm temperatures bring on powdery mildew, which is a common and often debilitating disease, particularly for *Phlox paniculata*. A number of other fungal leaf spot diseases may infect lower leaves but are usually less damaging than mildew. Additionally, spider mites, rabbits, and deer can be significant pests. Two-spotted spider mites infest the undersides of leaves, especially during hot, dry periods, causing stippling as they suck out nutrients. Leaves disfigured by spider mites usually appear puckered and chlorotic. Beyond the cosmetic aspect, spider mite infestations reduce the overall health of the plant.

Border phlox are often touted as the backbone of the summer garden because of their tall stature and exuberant flowers. In recent years breeding has reduced the height of many of the new cultivars, but border phlox still provide color in the heat of midsummer when many perennials have slowed down. By careful selection, it is possible to grow multiple border phlox for almost continual bloom throughout the summer. Partner tall border phlox with other garden amazons such as joe-pye weed (*Eupatorium* spp.), bee balm (*Monarda didyma*), and switch grass (*Panicum virgatum*). Whether tall or short, in full

sun or partial shade, border phlox mix well with Shasta daisies, balloon flowers, daylilies, astilbes, meadowsweets, and yellow wax bells. And of course, border phlox are superb as cut flowers in fresh floral arrangements.

The Evaluation Study

From 2001 through 2009, the Chicago Botanic Garden (USDA Hardiness Zone 5b, AHS Plant Heat Zone 5) evaluated 78 *Phlox* taxa in full-sun trials. The goal of the comparative trial was to identify outstanding border phlox for the Upper Midwest. The study concentrated on cultivars of *Phlox paniculata* but included *P. xarensii* cultivars as well as a number of unspecified hybrid cultivars.

In a previous trial from 1993 through 1996, the Chicago Botanic Garden evaluated a variety of spring- and summer-blooming phlox. Ten of the 20 taxa evaluated were cultivars of *Phlox paniculata*, including 'Katherine', which was the top-rated, mildew-resistant garden phlox in the trial. Results of the 1993–96 phlox trial can be downloaded at www.chicagobotanic.org/plantevaluation/. Feedback after the trial confirmed that a more comprehensive trial of *P. paniculata* cultivars would be worthwhile. Undertaking our second trial in stages over a nine-year period

made it possible to evaluate many new cultivars, thereby keeping our trial current.

Five plants of each taxon were grown in side-by-side plots for easy comparison of ornamental traits and landscape performance. The evaluation garden was openly exposed to wind in all directions and received approximately ten hours of full sun daily during the growing season, which averaged 164 days per year for the trial period. The clay-loam soil was amended with composted leaves and had a pH of 7.4 throughout the evaluation term. The site was normally well drained, but at times the soil retained moisture for short periods in summer and winter. Weather conditions at the test site are shown in Table 1 (below).

Maintenance practices were kept to a minimum, thereby allowing plants to thrive or fail under natural conditions. Water was provided via overhead irrigation as needed and mulch consisting of shredded leaves and wood chips helped with water conservation and weed suppression. Moreover, plants were not fertilized, winter mulched, or chemically treated for insect or disease problems. The test garden was surrounded by an electric fence to deter deer browsing. Plants were cut back in fall and debris was removed from the garden.

Table 1: Weather Summary for 2001–09

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lowest temperature °F (°C)	-4(-20)	-5(-21)	-5(-21)	-9(-23)	-2(-19)	-8(-22)	-10(-23)	-6(-21)	-17(-27)
Lowest temperature date	1/1	3/4	1/27	1/30	12/7	2/18	3/5	1/20	1/16
Highest temperature °F (°C)	98(37)	101(38)	98(37)	93(34)	100(38)	100(38)	96(35)	93(34)	96(35)
Highest temperature date	6/29	7/21	8/22	6/6	6/24	7/31	7/9	7/17	8/9
Number of growing-season days ^a	171	146	150	155	158	143	196	181	175
Number of days below 0°F (-18°C)	2	1	4	10	2	2	11	16	8
Number of days above 90°F (32°C)	19	30	15	5	24	15	20	6	7
Last frost date	4/19	5/21	5/4	5/3	5/4	5/7	4/16	4/30	4/18
First frost date	10/7	10/14	10/1	10/5	10/23	10/12	10/28	10/28	10/10
Annual rainfall in inches (cm) ^b	44.3(112.5)	33.6(85.3)	31.7(80.5)	35.5(90.2)	24.4(61.9)	42.5(107.9)	41.0(104.1)	49.5(125.7)	38.8(95.5)
Annual snowfall in inches (cm) ^c	10.9(27.7)	37.6(95.5)	15.6(39.6)	27.2(69.1)	44.4(112.7)	23.4(59.4)	38.5(97.8)	78.5(199.4)	28.8(75.2)

^aAverage length of growing season is 161 days.

^bAverage rainfall is 35.8 inches (90.9 cm).

^cAverage snowfall is 38.1 inches (96.8 cm).

Data was collected at the Chicago Botanic Garden weather station.

Latitude: 41°51'N. Longitude: 87°37'W. Altitude: 578.74 ft. (176.4m)

Performance Report

Beginning in June 2001, plants were regularly observed for descriptive traits such as flower color, bloom period, foliage color, and plant habit. In addition, data was collected on disease and pest problems, winter injury, and habit quality and plant health issues related to and/or affected by cultural and environmental conditions. Table 2 (pages 4-5) shows the descriptive traits and final performance ratings for 75 of the 78 taxa in the trial. Although 'Nicky' and 'Darwin's Joyce' finished the trial, they are considered synonyms of 'Düsterlohe' and 'Norah Leigh', respectively. All plants of 'Jeana' were inadvertently removed in the spring of the third year and not replaced; thusly, not included in Table 2 with taxa that completed a full evaluation term. Wherever possible, nomenclature follows the recommendations of the Royal Horticultural Society (*RHS Plant Finder*, 2011).

While 27 phlox received high ratings for outstanding flower production, good health, and strong habits, only *Phlox paniculata* 'Shortwood' received a five-star excellent rating for its exceptional overall performance and superior resistance to powdery mildew and spider mites. Rosy-pink 'Shortwood' is a chance seedling of white-flowered 'David', discovered by Sinclair Adam in Pennsylvania and named for the garden of Stephanie Cohen, perennial plant expert and garden writer. At 50 inches tall, 'Shortwood' is anything but short. In fact, with its large size and vivid flower color, somewhat of a throwback to the species, 'Shortwood' defies the recent trend in phlox introductions. But its noteworthy resistance to powdery mildew sets 'Shortwood' apart.

Generally speaking, the border phlox provided outstanding floral displays—a myriad of colors, fragrance, stout inflorescences, and long bloom periods. Flower production was predominantly excellent, with only a handful of cultivars receiving lower ratings of 40 to 60 percent coverage at peak bloom. Bloom periods in Table 2 are inclusive of the primary and secondary cycles, which consist of the first flowers in terminal clusters followed by, after a short period of inactivity, axillary flowers. Individual flowers varied in size from ½ inch to nearly 2 inches wide, and inflorescences averaged 5 inches tall and 6 inches



Powdery mildew on phlox

wide. However, the mammoth inflorescences of 'Rosa Goliath' were the largest, at 8 inches tall and 6 inches wide.



Phlox paniculata 'Robert Poore'

Pink, in a multitude of shades, was the predominant flower color in the trial. Purple, including violet and magenta, was a close second with white, blue, lavender, orange, and red also represented. A contrasting eye in the throat of the corolla tube was often present. Describing flower color is subjective, so color designations may not compare exactly with published descriptions. When necessary, the RHS Colour Chart was used to clarify similarities between specific cultivars.

Uniquely different from other garden phlox, 'Sherbert Cocktail' opens pink, eventually turning white with a pink blush and yellow petal tips. Its maroon calyces appear almost black from a distance, further enhancing the floral display. The pretty pink-and-white striped flowers of 'Peppermint Twist' were unique in the trial and reminiscent of a Starlight mint. Salmon-pink cultivars such as 'Candy Floss', 'Bartwelve', 'Becky Towe', 'Fairest One', 'Pink Attraction', and 'Rainbow' seemed to alternate between looking pink one day and orange on another. Purple-flowered 'Blue Paradise' opened from blue buds and faded to blue. Paradoxically, 'Ending Blue' had violet flowers streaked with white but did not turn blue at the end.

In a departure from traditional cultivar selection and development, the Feeling Series, bred by Rene van Gaalen of the Netherlands for the cut-flower market, exchanges texture for color. Rather than colorful blossoms, these idiosyncratic cultivars feature tight clusters of leafy sepals or bracts, which are more reminiscent of plume cockscomb (*Celosia argentea* Plumosa Group) than phlox. The petals, if present, are either tiny or reduced to slender straplike vestiges, while the green sepals may be tinged with bronze or purple. While the Feeling Series is innovative, its peculiarity is of dubious garden merit.

Table 2: Plant Traits and Performance Ratings

Overall Rating	Phlox	Flower Color	Flower Size	Bloom Period ¹	Flower Coverage	Plant Height	Plant Width	Mildew Resistance ²	Mite Infestation ³
★★★½	'Candy Floss'	coral pink	1¼ in.	early Jul-mid Sep	80-100%	28 in.	28 in.	excellent	moderate
★★★★½	'Fliedertraum'	violet purple	1½ in.	early Jul-early Oct	80-100%	40 in.	34 in.	good	moderate
★★★★	'Graefin von Schwerin'	light purple, magenta eye	1½ in.	early Jul-late Aug	40-60%	38 in.	36 in.	good	low
★★★★★	'Kraftprotz'	deep pink	1½ in.	early Aug-early Nov	80-100%	38 in.	34 in.	good	none
★★★★★	'Sherbert Cocktail'	soft pink, greenish yellow	1 in.	mid Jul-early Sep	80-100%	39 in.	22 in.	excellent	moderate
★★★★★	'xarendsii' 'Babyface'	pink, red eye	1 in.	mid Jul-early Sep	80-100%	29 in.	22 in.	fair	none
★★★★½	'xarendsii' 'Miss Jill'	white, pink eye	¾ in.	early Jul-mid Sep	60-80%	40 in.	32 in.	fair	low
★★★★★	'xarendsii' 'Miss Karen'	bright pink, darker eye	1 in.	late Jun-early Sep	60-80%	38 in.	34 in.	good	low
★★★★★	'xarendsii' 'Miss Margie'	violet purple	¾ in.	late Jun-early Sep	80-100%	35 in.	26 in.	good	low
★★★★★	'xarendsii' 'Miss Mary'	cherry red	1¼ in.	mid Jul-mid Sep	80-100%	38 in.	34 in.	good	low
★★★★½	'xarendsii' 'Ping Pong'	light purple, darker eye	1¼ in.	early Jul-mid Sep	80-100%	35 in.	27 in.	good	low
★★★★½	'xarendsii' 'Pink Attraction'	bright pink, orange cast	1¼ in.	early Jul-mid Sep	80-100%	32 in.	34 in.	good	moderate
★★★★½	'xarendsii' 'Sabine'	light purple	1 in.	mid Jul-late Aug	80-100%	44 in.	35 in.	good	low
★★★★★	'maculata' 'Flower Power'	white, pink blush	1 in.	early Jul-mid Aug	80-100%	49 in.	40 in.	excellent	none
★★★★½	'paniculata' 'Barci'	light pink, darker eye	1 in.	mid Jul-early Sep	80-100%	39 in.	45 in.	poor	none
★★★★★	'paniculata' 'Barfourteen'	purple violet	1¼ in.	mid Jun-mid Sep	60-80%	34 in.	34 in.	fair	low
★★★★★	'paniculata' 'Bartwelve'	salmon pink, darker eye	1¼ in.	late Jun-early Sep	80-100%	27 in.	22 in.	excellent	moderate
★★★	'paniculata' 'Becky Towe'	salmon pink, pink eye	1¼ in.	late Jul-early Sep	60-80%	24 in.	14 in.	excellent	none
★★★★	'paniculata' 'Blue Paradise'	violet blue	1½ in.	late Jun-early Sep	80-100%	34 in.	28 in.	good	low
★★★★★	'paniculata' 'Crème de Menthe'	light pink, darker eye	1 in.	late Jul-early Oct	80-100%	36 in.	30 in.	good	none
★★★★★	'paniculata' 'Danielle'	white	1¼ in.	late Jun-early Sep	40-60%	45 in.	30 in.	good	low
★★★★★	'paniculata' 'Delta Snow'	white, purple eye	1 in.	early Jul-mid Sep	80-100%	52 in.	40 in.	good	low
★★★★★	'paniculata' 'Dorfreude'	purple pink, darker eye	1¼ in.	early Jul-mid Sep	60-80%	38 in.	30 in.	good	none
★★★★½	'paniculata' 'Dunbar Creek'	white	¾ in.	early Jul-late Sep	80-100%	50 in.	36 in.	good	low
★★★★★	'paniculata' 'Düsterlohe'	red purple	1¾ in.	early Jul-late Sep	60-80%	40 in.	34 in.	good	low
★★★★½	'paniculata' 'Eden's Glory'	white	1¼ in.	late Jun-mid Sep	40-60%	24 in.	26 in.	good	low
★★★★★	'paniculata' 'Eden's Glow'	magenta	1⅞ in.	mid Jul-early Sep	40-60%	37 in.	24 in.	good	low
★★★★½	'paniculata' 'Eden's Smile'	pink	1¼ in.	mid Jul-mid Sep	80-100%	42 in.	40 in.	fair	none
★★★★½	'paniculata' 'Empty Feelings'	green, bronze cast	na	early Jul-early Oct	80-100%	30 in.	20 in.	good	moderate
★★★★	'paniculata' 'Ending Blue'	violet, magenta eye	1¼ in.	early Jul-mid Sep	60-80%	30 in.	28 in.	good	low
★★★	'paniculata' 'Fairest One'	salmon pink	1½ in.	early Jul-mid Sep	60-80%	28 in.	25 in.	good	low
★★★★★	'paniculata' 'Fancy Feelings'	deep pink	¾ in.	late Jun-early Oct	80-100%	30 in.	24 in.	good	low
★★★★½	'paniculata' 'Fesselballon'	light purple, darker eye	1¾ in.	late Jun-early Sep	80-100%	40 in.	28 in.	good	low
★★★★★	'paniculata' 'Fondant Fancy'	bright pink, magenta eye	1¼ in.	early Jul-early Sep	80-100%	25 in.	27 in.	good	moderate
★★★★★	'paniculata' 'Frosted Elegance'	pale pink, darker eye	⅞ in.	mid Jul-early Oct	60-80%	40 in.	30 in.	excellent	low
★★★★★	'paniculata' 'Giltmine'	rosy magenta	1 in.	early Jul-mid Sep	60-80%	24 in.	18 in.	excellent	low
★★★	'paniculata' 'Goldmine'	bright magenta	1 in.	mid Jul-early Sep	80-100%	20 in.	24 in.	excellent	none
★★★½	'paniculata' 'Grenadine Dream'	red purple	1¼ in.	early Jul-late Aug	80-100%	25 in.	21 in.	good	moderate

★★★½	<i>paniculata</i> 'Harlequin'	magenta	1 in.	mid Jul-mid Sep	80-100%	31 in.	18 in.	good	low
★★★	<i>paniculata</i> 'Hesperis'	light purple	¾ in.	mid Jul-late Sep	80-100%	43 in.	32 in.	fair	none
★★★	<i>paniculata</i> 'Inta'	pink, darker eye	1 in.	mid Jun-late Aug	80-100%	37 in.	34 in.	good	low
★★★	<i>paniculata</i> 'Iris'	bright violet	1½ in.	late Jun-mid Aug	60-80%	18 in.	18 in.	good	low
★★★	<i>paniculata</i> 'John Farnick'	pink two-tone	1 in.	late Jul-late Sep	80-100%	46 in.	46 in.	good	low
★★★	<i>paniculata</i> 'Jubilee'	orange magenta	1½ in.	mid Jul-late Sep	60-80%	32 in.	38 in.	fair	low
★★★	<i>paniculata</i> 'Karmin Grand'	rose red	1¼ in.	early Jul-early Sep	60-80%	39 in.	32 in.	good	low
★★★	<i>paniculata</i> 'Katherine'	lavender, white eye	1¼ in.	late Jun-mid Sep	80-100%	38 in.	36 in.	good	low
★★★	<i>paniculata</i> 'Laura'	purple, darker eye	1½ in.	early Jul-late Sep	80-100%	29 in.	26 in.	good	low
★★★	<i>paniculata</i> 'Lichtspel'	pink, red eye	1 in.	mid Jul-early Oct	60-80%	57 in.	34 in.	excellent	low
★★★½	<i>paniculata</i> 'Little Boy'	violet purple, white eye	1 in.	early Jul-late Aug	80-100%	33 in.	33 in.	good	low
★★★½	<i>paniculata</i> 'Little Princess'	deep pink	1½ in.	early Jul-mid Sep	60-80%	40 in.	27 in.	fair	none
★★	<i>paniculata</i> 'Lizzy'	purple	1¼ in.	late Jun-mid Aug	40-60%	na	na	excellent	none
★★★	<i>paniculata</i> 'Look Again'	magenta	1¼ in.	mid Jul-early Sep	80-100%	40 in.	30 in.	good	low
★★★½	<i>paniculata</i> 'Midnight Feelings'	green, reddish cast	na	early Jul-early Oct	80-100%	36 in.	36 in.	good	low
★★★	<i>paniculata</i> 'Miss Ellie'	pink two-tone	1¼ in.	early Jul-mid Sep	80-100%	38 in.	32 in.	good	low
★★	<i>paniculata</i> 'Miss Universe'	white	1 in.	mid Jul-mid Sep	60-80%	48 in.	31 in.	good	low
★★★½	<i>paniculata</i> 'Natural Feelings'	rosy pink and green	½ in.	mid Jul-mid Sep	80-100%	28 in.	22 in.	excellent	low
★★★½	<i>paniculata</i> 'Norah Leigh'	pale pink, darker eye	⅞ in.	late Jul-mid Sep	40-60%	34 in.	22 in.	good	none
★★★	<i>paniculata</i> 'Orange Perfection'	orange, magenta eye	1 in.	mid Jul-mid Sep	80-100%	36 in.	24 in.	good	low
★★★	<i>paniculata</i> 'Peppermint Twist'	pink and white	1¼ in.	early Jul-early Sep	60-80%	32 in.	31 in.	excellent	low
★★★	<i>paniculata</i> 'Pinky Hill'	light pink, darker eye	1¼ in.	mid Jul-mid Sep	40-60%	46 in.	40 in.	good	low
★★	<i>paniculata</i> 'Pleasant Feelings'	bright green	na	early Jul-late Sep	80-100%	24 in.	20 in.	excellent	low
★★	<i>paniculata</i> 'Rainbow'	pink, orange cast	1¼ in.	early Jul-early Sep	40-60%	34 in.	34 in.	excellent	moderate
★★★	<i>paniculata</i> 'Red Feelings'	purple red	⅝ in.	early Jul-mid Sep	80-100%	34 in.	28 in.	good	low
★★★	<i>paniculata</i> 'Red Magic'	red purple	1½ in.	early Jun-mid Sep	60-80%	32 in.	26 in.	good	low
★★★½	<i>paniculata</i> 'Red Riding Hood'	red	1¼ in.	mid Jul-mid Sep	80-100%	36 in.	34 in.	good	low
★★★	<i>paniculata</i> 'Robert Poore'	purple	1 in.	mid Jul-early Sep	60-80%	54 in.	40 in.	good	none
★★★	<i>paniculata</i> 'Rosa Goliath'	lavender pink	1½ in.	mid Jul-early Sep	60-80%	51 in.	36 in.	good	low
★★★	<i>paniculata</i> 'Rowie'	light pink, darker eye	1½ in.	late Jun-mid Sep	80-100%	26 in.	24 in.	good	low
★★	<i>paniculata</i> 'Rubymine'	pink, darker eye	1 in.	mid Jul-late Aug	60-80%	22 in.	20 in.	excellent	none
★★★	<i>paniculata</i> 'Shortwood'	rosy pink	1 in.	mid Jul-early Oct	80-100%	50 in.	34 in.	excellent	none
★★★½	<i>paniculata</i> 'Swirly Bury'	lavender w/magenta eye	1 in.	early Jul-early Sep	80-100%	24 in.	21 in.	excellent	moderate
★★★	<i>paniculata</i> 'Tenor'	magenta	1¾ in.	late Jun-early Sep	60-80%	52 in.	36 in.	good	low
★★★	<i>paniculata</i> 'Uspekh'	purple, white eye	1¼ in.	mid Jul-late Sep	80-100%	40 in.	32 in.	good	low
★★★	<i>paniculata</i> 'Violetta Gloriosa'	pale purple, violet streaks	1¾ in.	late Jun-early Sep	80-100%	38 in.	34 in.	fair	low
★★★½	<i>paniculata</i> 'Wendy House'	bright red purple	1¼ in.	early Jul-mid Sep	80-100%	26 in.	20 in.	excellent	moderate

Overall Ratings: ★★★ excellent,★★★ good, ★★ fair, ★ poor, ★ very poor; half-star ratings included

¹Bloom Period: inclusive of initial bloom cycle and subsequent late-season flowering

²Mildew Resistance: excellent, no infection; good <25% infection; fair 26-50% infection; poor 51-75% infection; very poor >76%

³White Infestation: low <25%; moderate 26-50%; severe >50%

Petals in the Feeling Series were generally lacking or greatly reduced in size, thus relying on the sepals for the ornamental display. The lack of petals made it difficult to accurately track the exact bloom time, so the flowering period refers to the length of time that the inflorescences remained ornamental. While the petal-less cultivars were fresh looking for a protracted period, they eventually declined to the point where deadheading was necessary to improve the display. As the dense inflorescences blackened with age they were reminiscent of witches'-broom caused by aphids on honeysuckles.

'Empty Feelings' featured bronze-tinged green sepals, *sans* petals, subtended by red-purple leaves. 'Midnight Feelings' was similar to 'Empty Feelings' but with slightly darker reddish purple sepals. Likewise, 'Pleasant Feelings' lacked petals but had bright green sepals. 'Fancy Feelings' provided the best floral display of the group, with deep pink, straplike petals and purple sepals that remained ornamental long after the petals dropped. The stubby pink petals of 'Natural Feelings' were streaked with green; unfortunately, the petals tended to hang brown as they faded, thus increasing the need for deadheading. The rudimentary petals of 'Red Feelings' poked slightly out of the calyx and were the same purple-red color as the sepals. All cultivars, except for 'Pleasant Feelings', had purple new leaves and flower buds.

Foliage was predominantly medium green with some shade variations observed; for example, 'Graefin von Schwerinn' and 'Miss Universe' had lighter green leaves than other cultivars. It was not uncommon for the terminal leaves just under the developing inflorescences to be purple, especially early in the season. Among the cultivars with dark purple terminal leaves were 'Blue Paradise', 'Düsterlohe', 'Iris', 'Jubilee', 'Karmin Grand', 'Little Princess', 'Ping Pong', 'Robert Poore', 'Rubymine', and 'Tenor'. Among the variegated cultivars in the trial were 'Crème de Menthe', 'Frosted Elegance', and 'Norah Leigh', which had irregular creamy-white margins, although 'Norah Leigh' had a wider variegation than the others.

Unfortunately, reverted stems were not uncommon on these cultivars. 'Giltmine' was weakly variegated with narrow yellow edg-



Phlox maculata 'Flower Power'

Richard Hawke

es; an abundance of non-variegated green stems were produced each year, and by the third year one variegated stem remained in one plant only. By contrast, 'Goldmine' displayed broad golden to creamy-yellow margins; variegation on some leaves was fully and deeply yellow in late June, becoming creamy yellow in August. Interestingly, the tiny leaves within the inflorescences were bright gold when the variegation was creamy yellow, giving 'Goldmine' a singular look. Like 'Giltmine', there were no variegated stems remaining on 'Goldmine' by the fourth year. Several variegated cultivars were prominently tricolored with purple to red overtones. 'Rubymine' featured purple highlights over creamy variegation, while yellow-rimmed 'Becky Towe' and cream-variegated 'Harlequin' were generously brushed with red. Sunscald was common on all variegated cultivars in late summer.

Plant habits were generally good with strong, erect stems; however, occasionally stems would be pulled down by the weight

of the flowers. Among the cultivars with especially sturdy stems and robust habits were 'Barci', 'Dunbar Creek', 'Eden's Smile', 'Flower Power', 'Inta', 'John Fanick', 'Lichtspel', 'Miss Margie', 'Miss Mary', 'Shortwood', 'Uspek', and 'Violetta Gloriosa'. While border phlox are generally clump-forming, slightly rhizomatous habits were noted on 'Barci', 'Eden's Smile', 'Inta', 'John Fanick', and 'Lichtspel'. Deep purple stems enhanced the ornamental quality of certain cultivars, such as 'Barci', 'Blue Paradise', 'Jubilee', 'Lichtspel', and *Phlox maculata* 'Flower Power'. 'Barci' was essentially a larger version of 'Baby Face', with purple stems and an overall robust, upright habit. 'Barfourteen' (Purple Flame) is supposedly a dwarf selection, but it reached 34 inches in the trial. Likewise, 'Little Boy' and 'Rainbow' were larger than expected based on literature descriptions. 'Blue Paradise' consistently had a loose to irregular habit each year. It was common for lower leaves to drop due to fungal leaf-spot diseases; the bare stems ultimately impacted the habit

quality for many cultivars. 'Becky Towe' was particularly prone to this problem; in addition, fusarium stem rot caused a portion of the stems of 'Becky Towe' to die each year. The Mine Series were generally not strong plants, and the number of variegated stems declined each year until mostly green stems were present in the third and fourth years.

Powdery mildew can be a significant problem for border phlox and *Phlox paniculata* cultivars in particular (see sidebar on page 10). Resistance or susceptibility to mildew infection is regional and seasonal in nature. For example, cultivars thought to be resistant in northern climates are often not so in warmer, more humid climates with longer growing seasons. And weather and cultural conditions may be more conducive to mildew infection in one year but not in the next. Although observed in all years of the trial except 2002, powdery mildew was a significant health issue in 2004, with 84 percent of the trial group infected at some level.

Over the course of the nine-year trial, 57 of 75 taxa were impacted by powdery mildew in one or more years. No cultivar had mildew in all years of its trial; only *Phlox xarendsii* 'Babyface', *P. paniculata* 'Barci', 'Barfourteen', 'Eden's Smile', and 'Jubilee' recorded mildew infection in three out of four trial years (see Table 3 on page 8). Occasionally, mildew was observed on the inflorescences but did not spread to the foliage. This type of infection was considered more cosmetic than a health issue because plant vigor did not seem to be adversely impacted. In some cases mildew developed late in the season, in September or October, so summer displays were not diminished. Taxa displaying the greatest resistance to powdery mildew in all years of the trial included 'Candy Floss', 'Sherbert Cocktail', 'Flower Power', 'Bartwelve', 'Becky Towe', 'Frosted Elegance', 'Giltmine', 'Goldmine', 'John Fanick', 'Lichtspel', 'Natural Feelings', 'Peppermint Twist', 'Pleasant Feelings', 'Rainbow', 'Rubymine', 'Shortwood', 'Swirly Burly', and 'Wendy House'.

Spider mites were an unexpected pest when first discovered in 2004 because they had not been observed in the 1993–96 trial. The number of cultivars with spider mite infestations grew gradually from 2004 until

2008 when 82 percent of taxa were affected. Leaves infested with spider mites were generally sickly in appearance, often appearing stippled or chlorotic and puckered. Severe mite damage resulted in defoliation and reduced plant vigor. *Phlox xarendsii* 'Pink Attraction', 'Fondant Fancy', and 'Rainbow' were the only taxa with mites noted in three of the four trial years (see Table 3 on page 8).

Although a deer exclusion fence surrounded the garden, lapses in securing the gates occurred several times in 2001, 2002, and 2003, allowing deer to enter the gardens one or two nights each summer. No deer browsing was observed in 2004–09. Forty-four taxa were affected by deer browsing, ranging from nibbling a few tips to severe browsing of all stem tips. The deer were particularly voracious in 2003, with 17 of the 43 browsed taxa incurring severe damage to all stems. Although deer browsing did not adversely affect the health of a plant, severe browsing resulted in reduced flower production and/or delayed bloom times. Browsing was typically confined to a one-time occurrence for each affected taxon each summer, but several cultivars were browsed in all three years,

including 'Düsterlohe', 'Eden's Glow', 'Fliedertraum', 'Frosted Elegance', 'Graefin von Schwerinn', 'Lichtspel', 'Norah Leigh', 'Shortwood', and 'Uspek'. Although it is clear from our trial that deer will eat border phlox, we did not definitively conclude that one cultivar over another is more prone to browsing.

Rabbits were infrequent visitors to the test garden prior to 2006; in 2001 damage was noted on 'Fliedertraum', 'Fairest One', and 'Miss Mary' only. An overpopulation of rabbits in 2006 and 2007 resulted in rabbits moving into the test garden from the adjacent woodland. Rabbit browsing declined significantly in 2008 when a portion of the woodland habitat was removed during construction of the Daniel F. and Ada L. Rice Plant Conservation Science Center. Overall, rabbit damage was insignificant and not widespread in the phlox trial. Damage was typically localized to adjacent taxa; for example, 'Wendy House' and 'Flower Power' grew side by side and were browsed at the same time in 2006 and 2007. However, 'Flower Power' was the only phlox that was browsed in three successive years, with many stems reduced in size by one half or more.



Phlox paniculata 'Frosted Elegance'

Table 3: Powdery Mildew Infection and Spider Mite Infestation by Year

Phlox	2001	2002	2003	2004	2005	2006	2007	2008	2009
'Candy Floss'						■	■	■	■
'Fliedertraum'	■	■	■	■■					
'Graefin von Schwerinn'	■	■	■	■■					
'Kraftprotz'	■	■	■	■	■				
'Sherbert Cocktail'						■	■	■	■
× <i>arendsii</i> 'Babyface'				■	■	■	■		
× <i>arendsii</i> 'Miss Jill'		■	■	■	■■				
× <i>arendsii</i> 'Miss Karen'	■	■	■	■	■				
× <i>arendsii</i> 'Miss Margie'	■	■	■	■	■				
× <i>arendsii</i> 'Miss Mary'	■	■	■	■	■				
× <i>arendsii</i> 'Ping Pong'	■	■	■	■	■				
× <i>arendsii</i> 'Pink Attraction'				■	■	■	■■		
× <i>arendsii</i> 'Sabine'		■	■	■	■				
<i>maculata</i> 'Flower Power'						■	■	■	■
<i>paniculata</i> 'Barci'				■	■	■	■		
<i>paniculata</i> 'Barfourteen'				■	■■	■	■		
<i>paniculata</i> 'Bartwelve'				■	■	■	■		
<i>paniculata</i> 'Becky Towe'	■	■	■	■	■				
<i>paniculata</i> 'Blue Paradise'	■	■	■	■	■■				
<i>paniculata</i> 'Crème de Menthe'				■	■	■	■		
<i>paniculata</i> 'Danielle'	■	■	■	■	■				
<i>paniculata</i> 'Delta Snow'	■	■	■	■	■				
<i>paniculata</i> 'Dorffreude'	■	■	■	■	■				
<i>paniculata</i> 'Dunbar Creek'		■	■	■	■				
<i>paniculata</i> 'Dusterlohe'	■	■	■	■	■				
<i>paniculata</i> 'Eden's Glory'	■	■	■	■	■				
<i>paniculata</i> 'Eden's Glow'	■	■	■	■	■■				
<i>paniculata</i> 'Eden's Smile'			■	■	■	■	■		
<i>paniculata</i> 'Empty Feelings'					■	■	■	■■	
<i>paniculata</i> 'Ending Blue'				■	■	■	■■		
<i>paniculata</i> 'Fairest One'	■	■	■	■	■■				
<i>paniculata</i> 'Fancy Feelings'					■	■	■	■■	
<i>paniculata</i> 'Fesselballon'	■	■	■	■	■				
<i>paniculata</i> 'Fondant Fancy'						■	■■	■■	■
<i>paniculata</i> 'Frosted Elegance'	■	■	■	■	■				
<i>paniculata</i> 'Giltmine'						■	■	■	×
<i>paniculata</i> 'Goldmine'					■	■	■	×	
<i>paniculata</i> 'Grenadine Dream'						■	■■	■■	■
<i>paniculata</i> 'Harlequin'		■	■	■	■				
<i>paniculata</i> 'Hesperis'			■	■	■	■	■		
<i>paniculata</i> 'Inta'	■	■	■	■■					
<i>paniculata</i> 'Iris'	■	■	■	■	■				
<i>paniculata</i> 'John Fanick'					■	■	■	■	
<i>paniculata</i> 'Jubilee'				■	■	■	■■		
<i>paniculata</i> 'Karmin Grand'	■	■	■	■■					
<i>paniculata</i> 'Katherine'	■	■	■	■	■				
<i>paniculata</i> 'Laura'				■	■				
<i>paniculata</i> 'Lichtspel'	■	■	■	■					
<i>paniculata</i> 'Little Boy'	■	■	■	■	■■				
<i>paniculata</i> 'Little Princess'	■	■	■	■	■				
<i>paniculata</i> 'Lizzy'			×						
<i>paniculata</i> 'Look Again'	■	■	■	■	■				
<i>paniculata</i> 'Midnight Feelings'					■	■	■	■■	
<i>paniculata</i> 'Miss Ellie'	■	■	■	■	■				
<i>paniculata</i> 'Miss Universe'	■	■	■	■	■■				
<i>paniculata</i> 'Natural Feelings'					■	■	■	■	
<i>paniculata</i> 'Norah Leigh'	■	■	■	■	■				
<i>paniculata</i> 'Orange Perfection'		■	■	■	■				
<i>paniculata</i> 'Peppermint Twist'						■	■	■	■
<i>paniculata</i> 'Pinky Hill'				■	■	■	■■		
<i>paniculata</i> 'Pleasant Feelings'					■	■	■	■	
<i>paniculata</i> 'Rainbow'				■	■	■	■		
<i>paniculata</i> 'Red Feelings'					■	■	■	■■	
<i>paniculata</i> 'Red Magic'	■	■	■	■	■				
<i>paniculata</i> 'Red Riding Hood'	■	■	■	■	■■				
<i>paniculata</i> 'Robert Poore'	■	■	■	■	■				
<i>paniculata</i> 'Rosa Goliath'	■	■	■	■■					
<i>paniculata</i> 'Rowie'					■	■	■	■■	
<i>paniculata</i> 'Rubymine'					■	■	■	×	
<i>paniculata</i> 'Shortwood'	■	■	■	■	■				
<i>paniculata</i> 'Swirly Burly'						■	■	■	■
<i>paniculata</i> 'Tenor'	■	■	■	■	■				
<i>paniculata</i> 'Uspekh'	■	■	■	■■					
<i>paniculata</i> 'Violetta Gloriosa'			■	■	■	■	■		
<i>paniculata</i> 'Wendy House'						■	■	■	■

■ powdery mildew ■ spider mites ■ no powdery mildew or spider mites observed × evaluation discontinued



Carol Freeman

Phlox paniculata 'Düsterlohe'

C. Provost

Phlox paniculata 'Katherine'

Carol Freeman

Phlox paniculata 'Red Magic'

Summary

Winter hardiness was not considered an issue for border phlox, although winter losses were noted in every year of the trial. For the most part, survivability during winter was influenced by the health of the plants during the preceding growing season. Plants significantly affected by powdery mildew, spider mites, and/or vascular wilt were generally less healthy going into winter. Some degree of plant loss, from crown injury to plant death, was observed on the affected plants the following spring. There was a direct correlation between reduced plant vigor in the summer preceding winter injury and plant loss; however, there was no obvious correlation between cold temperatures and plant injury or loss. For example, the greatest number of injury cases was noted in the winter of 2002–03, with 47 percent of taxa suffering crown loss or death, but that winter did not have the lowest temperature or the most number of days below zero. 'Lizzy' and 'Pleasant Feelings' were the only taxa with crown injury or plant loss noted in three successive winters. 'Lizzy' grew weakly throughout the trial, suffering plant loss and crown injury in the winters of 2001–02, 2002–03, and 2003–04; all plants were dead following the third winter. Plants of 'Pleasant Feelings' had serious crown loss in the winters of 2005–06 and 2006–07, and all but one plant was dead by the winter of 2007–08.

Over the nine-year span of our trial, an exceptional number of border phlox cultivars were introduced to gardeners featuring novel flower colors, variegated foliage, smaller plant sizes, and/or the promise of improved resistance to powdery mildew. Our trial of 78 phlox was representative of what was commercially available beginning in 2000. Twenty-seven of the 78 phlox in the trial received top ratings for their superior flower production, mildew resistance, strong habits, and winter hardiness. *Phlox paniculata* 'Shortwood' was the most outstanding of the group, receiving a five-star excellent rating for its exceptional overall performance and high resistance to powdery mildew and spider mites.

While the majority of phlox cultivars exhibited acceptable ornamental traits such as heavy flower production and robust habits each year, the incidences of powdery mildew infection and/or spider mite infestation varied by year and by cultivar. It is important to note that the seasonal and geographical aspect of powdery mildew must be considered in any discussion of anticipated resistance. For instance, a cultivar that has demonstrated high mildew resistance in the Chicago area may not be as disease-free in Atlanta, Fargo, or Philadelphia—or

conversely, may be more resistant. Generally designating a plant mildew resistant can be problematic, since there will always be exceptions related to geographical and environmental differences.

Several cultivars were not troubled by disease or pests but simply lacked vigor. For example, a number of variegated cultivars including 'Becky Towe', 'Goldmine', and 'Rubymine' were disease- and pest-free but exhibited weak habits and declining vigor in successive years of the trial. Winter hardiness was not an issue but crown injury or plant losses during winter were observed. Reduced health and vigor during the preceding growing season weakened the plants, which eventually died over winter.

Garden phlox are valued for their impressive floral displays, sweet fragrance, and long-blooming nature. The increasing desire for stronger, trouble-free garden phlox will undoubtedly fuel the market for these popular garden plants for many years to come. Through breeding and selection, new introductions in coming years will likely surpass many of the current offerings. In the end, testing border phlox in a variety of geographical areas will ensure that the best selections reach gardeners.

Powdery Mildew on Garden Phlox

Powdery mildew is a fungal disease that commonly affects leaves, stems, and inflorescences of *Phlox paniculata* as well as a number of other garden favorites such as asters, bee balms, lilacs, and roses. Although the disease manifests itself similarly on each host plant, there are actually a number of different species of powdery mildew that cause infection. Mildew shows itself as conspicuous white powdery spots that may remain discrete or coalesce into large patches covering entire leaves. Severely infected leaves may wilt and prematurely fall from the plant. Although powdery mildew does not kill plants outright, it can weaken them by feeding on the nutrients in the leaves. Repeated infections can significantly decrease plant vigor over time.

Symptoms are observed in summer and autumn when the development of the fungus is promoted by high temperatures and high night-time humidity. The reproductive spores are carried by wind and germinate under humid conditions. Selecting mildew-

resistant cultivars is the first line of defense against the disease. Unfortunately, the resistance or susceptibility of specific garden phlox cultivars to powdery mildew varies by geographic location. Regional studies at the University of Vermont (VT), Cornell University (NY), North Carolina State University (NC), and University of Arkansas (AR) provide recommendations for mildew-resistant phlox such as 'Delta Snow' (AR, NC), 'Robert Poore' (AR, NC), 'Blue Boy' (AR, VT), 'David' (AR, NC, NY), 'Orange Perfection' (NY, VT), 'Prime Minister' (NY, VT), 'Red Magic' (AR), Natascha' (NC), 'Speed Limit 45' (NC), and 'Eden's Crush' (AR).

A number of cultural practices may eliminate or reduce mildew in the garden. Management considerations include 1) thinning out a fourth of the stems to increase air circulation through the plant; 2) planting in full sun; 3) eliminating or reducing overhead irrigation; and 4) reducing the overwintering spores through removal of infected leaves and stems each autumn. Fungicides or hor-

ticultural oils and soaps can also be helpful in controlling the fungus. Research at Cornell University determined that a mixture of one tablespoon of baking soda and one teaspoon of lightweight horticultural oil or insecticidal soap in a gallon of water applied weekly helps to control powdery mildew.

Bir, D. 2003. Phlox Under Fire. *NMPro* 19(2):45-46.

Daughtrey, M., M. Macksel, L. Perry, S. Clark. 1993. Comparison of Phlox Cultivars for Susceptibility to Powdery Mildew. *Biological and Cultural Tests*: 129.

Perry, L.P. 1999. Powdery Mildew on Phlox and monarda. *The Journal of The Society of Municipal Arborists* 35(2):14.

Taylor, E., R. Cartwright, J. Robbins, G. Klingaman. 2001. Evaluation of *Phlox paniculata* Cultivars for Susceptibility to Powdery Mildew. *Horticultural Studies* 2001, University of Arkansas: 95-96.



Phlox paniculata 'Rowie'

Jessie V. Stevens

References

- Armitage, A.M. 2008. *Herbaceous Perennial Plants*, Third Edition. Champaign, IL: Stipes Publishing L.L.C.
- RHS Plant Finder*, Online Edition, 2010. www.rhs.org.uk/rhsplantfinder/plantfinder.asp.
- Rice, G., editor-in-chief. 2006. *American Horticultural Society Encyclopedia of Perennials*. New York, NY: DK Publishing, Inc.

The Plant Evaluation Program is supported by the Woman's Board of the Chicago Horticultural Society and the Searle Research Endowment. We gratefully acknowledge the generous donation of plants for the phlox trial from Darwin Plants®, de Vroomen Perennials, Simple Pleasures®, and Walters Gardens.

Plant Evaluation Notes© are periodic publications of the Chicago Botanic Garden. For more information or copies of back issues, contact the Plant Evaluation Program, Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, IL 60022 or visit www.chicagobotanic.org/research/plant_evaluation.