

Plant Evaluation Notes

Monarda and Powdery Mildew Resistance

Richard G. Hawke, Coordinator of Plant Evaluation Programs

Monarda is undeniably one of the showiest summer-blooming perennials, and the flash of its vibrant-colored flowers is positively captivating. But it is also notorious for its bad habits—invasiveness and a predisposition to powdery mildew. While those may be reasons enough to keep your distance, it can be difficult to resist its floral charms.

Monarda didyma, beebalm or Oswego tea, and *Monarda fistulosa*, wild bergamot, are the most commonly cultivated of the 16 species native to North America. Beebalm grows naturally in rich woodlands, in thickets and along streams throughout the eastern United States. It is not as tolerant of dry conditions as *Monarda fistulosa*, which grows on the drier soils of hillsides, meadows and prairies from southeastern Quebec to the southern United States.

Both species grow well in full sun or partial to light shade and are adaptable to a variety of soils. *Monarda didyma* requires rich, moist soils for best growth and may react to dry soils by developing foliar diseases. It is a

good choice for the perennial border because of its tolerance of the higher moisture level common in garden beds. Many of the commonly grown cultivars are often more tolerant of drier soils because they are actually hybrids of *M. didyma* and *M. fistulosa*.

Square stems and aromatic foliage mark *Monarda* as a member of the mint family (Lamiaceae). Its flowers are borne in terminal or axillary verticillasters, subtended by colorful, leafy bracts. *Monarda didyma* has scarlet-red flowers collared by red-tinged bracts, whereas the light lavender to pinkish-white flowers of *Monarda fistulosa* are surrounded by bracts that are often tinted with pink. The cultivars and hybrids come in a wide range of colors including rich shades of red, violet, purple, pink and white.

Both species have tall, sturdy stems and spreading habits. The basal shoots are plentiful and extremely vigorous, expanding outward to quickly increase the size of the plant. The fast growth rate causes the plant's center to become overcrowded and die out after three or four years. Plants should then be divided,

replanting only the vigorous perimeter shoots. *Monarda* often declines in health after flowering and should be cut to the ground late in the summer to promote the regeneration of healthy shoots and leaves.

Powdery mildew, the most common disease problem associated with *Monarda*, often contributes to the poor condition of plants in late summer. The disease appears as a grayish-white "powder" on the upper surfaces of the leaves, and severely infected foliage may be distorted or drop prematurely. The incidence of powdery mildew can be reduced by allowing good air movement between plants, ensuring the soil does not dry out, removing diseased leaves and stems to destroy the overwintering stage of the fungus and choosing mildew-resistant cultivars. Fungicides or horticultural oils can also be used to control powdery mildew.

Beebalm and bergamots are great perennials for meadows and wild gardens, along streams and ponds, in woodlands and also in the garden border. The boldness of beebalm makes it equally good for massing or as an accent, and it mixes well with other summer perennials such as phlox, iris, daylilies and yarrows. The long season of color attracts bees, butterflies and hummingbirds in July and August, and will capture your attention as well.

Evaluation Project

There are many *Monarda* cultivars available in the United States, some developed long ago, others recent introductions. Selection for resistance to powdery mildew is the priority today. In 1993 the Chicago Botanic Garden (USDA Hardiness Zone 5b, AHS Plant Heat-Zone 5) began a four-year evaluation project with the primary goal of determining mildew resistance among commercially available species and cultivars of *Monarda*. Plants were also evaluated for ornamental qualities, vigor, invasiveness and winter injury. Forty-one selections of *Monarda* were grown and evaluated between spring 1993 and autumn 1996.



Pam Duthie

'Marshalls Delight'

2 Plant Evaluation Notes

The evaluation plots received similar exposure to wind and approximately eight to 10 hours of full sun daily during the growing season. The well-drained soil consisted of one part composted leaves to four parts clay-loam soil, with a pH of 7.4. Turf grass pathways surrounded the beds on all sides, and the plots, each comprised of 16 plants, were separated within the beds by mulched strips.

Maintenance practices were kept to a minimum to simulate home garden culture. Irrigation was supplemented as needed, and no fertilizer was applied. The plants were periodically cut back in late summer to remove declining and/or diseased stems. Fungicides were not used to control powdery mildew so that accurate disease-resistance information could be collected. Infected leaves were removed from the ground in order to decrease

the level of fungal spores overwintering in the test garden. A mulch of shredded leaves and wood chips was placed around the plants for aesthetic purposes, water conservation and weed control.

Plants were obtained from various commercial and private sources throughout the United States and Canada, including the Agriculture Canada Research Station in Morden, Manitoba. The project was initiated jointly with the Morden station, and plants were shared between institutions. Some of the unnamed selections from the Morden breeding program were also included in the Chicago Botanic Garden trial. The evaluation list (Table 1) contains species and cultivars that were readily available in the U.S. and Canadian markets in 1993 and does not include the newer selections of mildew-

resistant cultivars that have come from Europe in the past few years. Nomenclature does not follow any one reference and has been simplified in most cases to the cultivar level because of the many discrepancies noted in the literature. To further simplify our discussion, beebalm is the common name used throughout this report to refer to all *Monarda* in the test program.

Observations

The *Monarda* trials were one of the most impressive displays ever grown in the concentric circles of the Lavin Plant Evaluation Garden. Immersed in the maze of exuberant colors, it was easy to forget the garden's purpose, but the side-by-side plots made it simple to compare ornamental characteristics and mildew resistance among the *Monarda*.

Table 1: Plant Characteristics and Performance Summary Ratings

Overall Rating	Monarda	Flower Color	Inflorescence Width	Bloom Period	Flower Coverage	Height Range	Powdery Mildew Resistance ¹	Winter Injury ²
★★	'Adam'	cerise	2½-3 in.	late Jun-early Aug	40-60%	36-47 in.	poor	yes
★★★★	'Aquareius'	vivid violet	2½ in.	early Jul-early Aug	60-80%	33-49 in.	poor	yes
★★	'Beauty of Cobham'	purplish pink	2½ in.	early Jul-mid Aug	60-80%	33-41 in.	very poor	yes
★★★★	(Blue Wreath) 'Blaukranz'	strong purplish red	2½ in.	early Jul-late Jul	80-100%	26-48 in.	fair to good	no
★★★★	'Blue Stocking'	vivid purple	2 in.	early Jul-mid Aug	40-60%	33-39 in.	fair	yes
★★	'Cambridge Scarlet'	vivid red	3½ in.	late Jun-late Aug	80-100%	27-49 in.	poor	some
★★★★	'Colrain Red'	deep purplish red	2½-3 in.	early Jul-mid Aug	80-100%	35-57 in.	good	yes
★★	'Croftway Pink'	rose pink	2½ in.	early Jul-early Aug	80-100%	34-48 in.	very poor	yes
★★★★	'Donnerwolke' (Thundercloud)	violet purple	2½ in.	mid Jul-mid Aug	60-80%	33-43 in.	poor	no
★★★★	'Falls of Hill's Creek'	red	4 in.	mid Jun-early Aug	80-100%	27-48 in.	fair	no
★★★★	'Firecrown' (Feuerschopf)	rose red	2½ in.	mid Jul-late Aug	80-100%	35-54 in.	fair	some
★★★★	'Gardenview Scarlet'	red	3-3½ in.	early Jul-mid Aug	80-100%	44-52 in.	fair to good	no
★★	'Granite Pink'	purplish pink	2½ in.	early Jul-early Aug	60-80%	25-48 in.	poor	yes
★★★★	'Kardinal'	purplish red	2½ in.	mid Jul-mid Aug	60-80%	29-57 in.	fair	yes
★★	'Mahogany'	deep purplish red	3½ in.	mid Jul-early Aug	40-60%	40-49 in.	very poor	some
★★★★★	'Marshalls Delight'	purplish pink	2½ in.	late Jun-early Aug	60-80%	30-46 in.	good	no
★	'Mrs. Perry'	red	3 in.	early Jul-early Aug	80-100%	48 in.	very poor	yes
★★★★	'Ohio Glow'	strong purplish red	2½ in.	early Jul-early Aug	80-100%	31-51 in.	fair to good	yes
★★	'Panorama'	deep purplish red	2½ in.	mid Jul-early Aug	60-80%	44-45 in.	poor	yes
★★★★	'Petite Delight'	lavender rose	2 in.	early Jul-mid Aug	60-80%	17 in.	fair	yes
★★	'Prairie Fire'	vivid purplish red	3 in.	early Jul-early Aug	60-80%	40-54 in.	very poor	yes
★★★★	'Prairie Night'	deep purple	2½ in.	early Jul-early Aug	80-100%	40-52 in.	poor	some
★★★★	'Purple Mildew Resistant'	strong purple	2-3½ in.	late Jun-late Jul	60-80%	32-39 in.	excellent	yes
★★	'Purpurkroné'	vivid purple	2-2½ in.	mid Jul-early Aug	80-100%	37-55 in.	poor	some
★★★★★	'Raspberry Wine'	strong purplish red	2 in.	early Jul-mid Aug	80-100%	42-52 in.	good	some
★★★★	'Rose Queen'	purplish red	2-3 in.	early Jul-early Aug	60-80%	40-46 in.	good	yes
★★★★★	'Rosy-Purple'	deep purplish red	2½-3½ in.	early Jul-late Aug	80-100%	40-60 in.	good	no
★★	'Snow Queen'	white	1½ in.	early Jul-mid Aug	60-80%	44-52 in.	very poor	some
★★★★	'Snow White'	white	2½ in.	mid Jul-mid Aug	40-60%	40-53 in.	fair	some
★★★★	'Souris'	reddish purple	2-3 in.	late Jun-late Jul	80-100%	25-42 in.	fair	yes
★★★★	'Squaw'	vivid red	2 in.	late Jun-late Jul	80-100%	32-49 in.	fair to good	yes
★★★★	'Stone's Throw Pink'	purplish pink	2-2½ in.	mid Jul-mid Aug	60-80%	34-53 in.	fair	yes
★★★★	'Sunset'	vivid purple	2-3½ in.	late Jun-late Jul	80-100%	39-47 in.	fair	yes
★★★★	'Violet Queen'	strong purple	2 in.	mid Jul-mid Aug	60-80%	42-51 in.	good	yes
★★★★	<i>didyma</i>	strong red	3 in.	early Jul-early Aug	80-100%	25-51 in.	poor	yes
★★★★	<i>didyma</i> 'Alba'	white	1½ in.	mid Jul-mid Aug	60-80%	36-49 in.	poor to fair	yes
★★	<i>fistulosa</i>	light purple	2-2½ in.	mid Jul-mid Aug	80-100%	40-50 in.	very poor	yes
★★	<i>fistulosa</i> 'Claire Grace'	strong purple	2 in.	mid Jul-mid Aug	80-100%	40-51 in.	poor	yes
★★★★	<i>fistulosa</i> f. <i>albescens</i>	white	1 in.	mid Jul-late Aug	60-80%	33-39 in.	good	yes

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

¹Powdery Mildew Resistance: excellent = no injury; good = <25% infection/leaf drop; fair = 26-50% infection/leaf drop; poor = 51-75% infection/leaf drop; very poor = >76% infection/leaf drop.

²Winter Injury: yes—more than one year with injury, minor to severe; no—no injury in any year; some—injury in one year only, minor to severe.

Information was collected on disease and pest resistance; flower color, size, bloom period and coverage; plant size and form; winter hardiness; and cultural adaptability. Plant traits and evaluation specifics are outlined in Table 1. Of the 41 original taxa, only three did not complete the project because of winter injury. A summary rating was assigned to each taxon based on mildew resistance, bloom coverage, plant health, habit quality and winter injury. A five-star rating indicates a superior performance, whereas a one-star rating signifies a poor performance.

Many of the taxa were obtained from multiple sources in an effort to verify the authenticity of commercially available plants. In most cases these taxa matched each other and were verified true to name. There were only a few instances where incorrect plants were removed from the trial. The project also included a plant received as *Monarda didyma* 'Gardenview Red', which was identical in appearance to 'Gardenview Scarlet' and was determined to be an invalid name per a phone conversation with Henry Ross, Gardenview Horticultural Park, Strongsville, Ohio.

Powdery mildew was the most significant disease problem observed. It was rarely noted before early July and was most severe in late summer and fall. White fungal patches developed on the upper surfaces of the leaves and, in the worst cases, the patches coalesced, making the entire leaf surface look grayish-white. Eight cultivars were highly resistant to mildew infection, including 'Colrain Red', 'Marshalls Delight', 'Purple Mildew Resistant', 'Raspberry Wine', 'Rose Queen', 'Rosy-Purple', 'Violet Queen' and *M. fistulosa* f. *albescens*. 'Marshalls Delight' had the lowest level of infection with no more than 5% ever observed, while the others typically had less than 25% foliar infection. Only 'Purple Mildew Resistant' was completely free of mildew throughout the evaluation period. In some cases, mildew infection on "resistant" cultivars was observed only on the leaves directly adjacent to highly susceptible cultivars. The most susceptible taxa were 'Beauty of Cobham', 'Croftway Pink', 'Mahogany', 'Mrs. Perry', 'Prairie Fire', 'Snow Queen' and *M. fistulosa*. Mildew was first noted on these plants sometimes as early as mid-June, with complete infection (100%) occurring in late July to early August.

Infection usually resulted in partial to full defoliation. The degree of infection did not always determine the amount of defoliation, although the two were often at the same level.

Some cultivars held infected leaves for most of the season while others defoliated quickly. 'Rosy-Purple' and 'Stone's Throw Pink' consistently had the lowest amount of leaf loss from mildew infection, typically less than 20%. This was attributed to the fact that infection on these plants occurred later in the season, peaking in severity in late August and September. Regeneration of leaves varied with each cultivar and in each year. Most plants began new growth as soon as mildew levels elevated, but sometimes new shoots did not emerge until late September or October, or only after the bare stems were cut back. The new leaves were rarely infected with powdery mildew.

Powdery mildew was most severe in 1994, with many cultivars having up to 100% infection and full leaf drop. With few exceptions, even the most resistant cultivars in other years had mildew levels above 50% in 1994. Cultivars with low infection levels in 1994 included 'Purple Mildew Resistant' (none), 'Marshalls Delight' (5%), 'Raspberry Wine' (10%) and *M. fistulosa* f. *albescens* (10%). Above-normal heat and humidity during early and mid-June of 1994 contributed to the early development of powdery mildew, while continued hot and humid days during July exacerbated the problem.

Fungal leaf spot was a serious disease problem in 1995. The specific pathogen was not isolated, but at least five species of fungi are known to cause leaf spot on *Monarda* (Pirone 1978). The disease was characterized by dark lesions that sometimes formed large necrotic areas on the leaves. The combination of leaf spot and powdery mildew infection resulted in the severe defoliation of most plants by late August and September. Cultivars with minor leaf spot damage and, consequently, less leaf thinning were 'Blue Wreath', 'Ohio Glow', 'Raspberry Wine', 'Rosy-Purple', 'Squaw', 'Stone's Throw Pink' and *M. fistulosa* 'Claire Grace'. In 1996 leaf spot was recorded at a much reduced level; only 'Purpurkrone' and 'Rose Queen' had over 30% of leaves infected that year.

Rust was observed in 1995 and 1996, but it was neither a widespread nor a serious problem. It was most pronounced on 'Kardinal' and 'Firecrown' with over 75% infection and on 'Purple Mildew Resistant' with all leaves infected and ultimately dropping. Other cultivars with minor rust damage were 'Blue Stocking', 'Raspberry Wine', 'Snow Queen', 'Snow White', 'Violet Queen' and *M. fistulosa* 'Claire Grace'.

No other flower in the evaluation program, except perhaps the dinner plate-sized flowers of *Hibiscus moscheutos*, captured the public's attention more than the profusion of glowing pinks, brilliant reds and deep purples of beebalm. Flower coverage of 80% to 100% was common for most plots, although some lower percentages were noted. Plants with nearly 100% coverage in all four evaluation years included 'Blue Wreath', 'Croftway Pink', 'Prairie Night', 'Raspberry Wine', 'Rosy-Purple', 'Souris', 'Squaw' and 'Sunset'. An overall decrease in flower production was observed on many plants in 1996, due mostly to a decline in health and vigor caused by crown die-out.

Bloom periods of 30 days were typical, although some plants had displays lasting six to eight weeks. The longest-blooming cultivars were 'Beauty of Cobham', 'Blue Stocking', 'Cambridge Scarlet', 'Colrain Red', 'Falls of Hill's Creek', 'Firecrown', 'Gardenview Scarlet', 'Marshalls Delight', 'Ohio Glow', 'Petite Delight', 'Raspberry Wine', 'Rosy-Purple', 'Snow Queen', 'Squaw' and *M. fistulosa* f. *albescens*. The peak bloom display normally lasted about two weeks.

Plant health was directly related to powdery mildew and leaf spot susceptibility, although winter injury and crown die-out were also contributing factors. As the plants aged, the centers slowly died out, creating open areas within each test plot. Although the perimeter shoots remained healthy, the brown, open crowns detracted from the ornamental display. The health and vigor of many of the beebalms declined dramatically by the last year of the trial because plants were never divided.

A few of the cultivars had exemplary forms because of sturdy stems, uniform heights and full habits. The plants with consistently good habits were 'Blue Wreath', 'Colrain Red', 'Gardenview Scarlet', 'Marshalls Delight', 'Ohio Glow', 'Purple Mildew Resistant', 'Raspberry Wine', 'Rosy-Purple', 'Squaw', 'Stone's Throw Pink' and 'Violet Queen'. The majority of beebalms grew together by the second year, leaving no open ground in the test plot. While all beebalms are spreading in nature, 'Blue Wreath', 'Beauty of Cobham' and 'Petite Delight' remained more clumplike. 'Blue Wreath' in particular retained its upright, oval habit and distinct form. Lodged stems were observed occasionally at the perimeter of a plot, but no cultivar demonstrated a propensity toward weak stems.



Michael Harvey

'Blue Wreath'



Richard Hawke

'Gardenview Scarlet'

The tallest plant heights were recorded in 1994 due to hot weather early in the season. Most plants ranged from 8 to 14 inches, and even up to 20 inches taller than usual that year. 'Petite Delight' was the only plant that remained the same height each year. Plants were shortest in 1996 due to a decline in plant vigor from winter injury and crown die-out.

In general, the *Monarda* selections were considered winter-hardy, although some degree of injury occurred in most years. A decrease in crown size and stem vigor was first observed after the winter of 1994-95 and again after the following winter. Taxa with crown damage of 50% or more in one or more years included 'Adam', 'Blue Stocking', 'Croftway Pink', 'Granite Pink', 'Kardinal', 'Mahogany', 'Panorama', 'Prairie Fire', 'Violet Queen', *M. didyma* 'Alba', *M. fistulosa* f. *albescens* and *M. fistulosa* 'Claire Grace'.

'Blue Wreath', 'Donnerwolke', 'Falls of Hill's Creek', 'Gardenview Scarlet', 'Marshalls Delight' and 'Rosy-Purple' had no winter injury. Only 'Mrs. Perry', *M. punctata* and *M. russeliana* were completely killed during winter. All plants of 'Mrs. Perry' and *M. russeliana* were killed after two seasons, and all plants of *M. punctata* died during the first winter.

Summary

We learned a great deal about *Monarda* in four years. We observed that powdery mildew was a serious disease and that many beebalms are susceptible to it; but we also discovered that a handful of cultivars are resistant. We measured the abundance and brilliance of flowers produced each summer and saw how they attracted bees, birds, butterflies and people. We tracked the rapid outward growth of stems by underground rhizomes. And in the end, we admitted that we liked *Monarda*.

There are many *Monarda* cultivars currently available in the U.S. with new selections still arriving from Europe. The 1997-98 edition of *The RHS Plant Finder* lists 61 hybrids or cultivars of *Monarda* available in England. Unfortunately, many nurseries in the United States offer a limited list of beebalm cultivars and are only beginning to sell the newer selections. We found that a number of the most commonly available cultivars were also some of the lowest-rated plants, for example, 'Beauty of Cobham' and 'Croftway Pink'.

Final ratings were based on resistance to powdery mildew, plant health, flower production and winter hardiness. Plant health was measured by the degree of powdery mildew, leaf spot or rust and stem vigor during the growing season and following each winter. A lesser rating in one category may not have affected the overall rating significantly,

whereas low ratings in more than one category often significantly decreased the final rating.

Ten cultivars were outstanding in overall performance, receiving at least a four-star rating: 'Blue Wreath', 'Colrain Red', 'Falls of Hill's Creek', 'Gardenview Scarlet', 'Marshalls Delight', 'Ohio Glow', 'Raspberry Wine', 'Rose Queen', 'Rosy-Purple' and 'Violet Queen'. These cultivars exhibited powdery mildew resistance, strong habits, high flower production and low winter injury.

Our trial was a bit unnatural because so many beebalms were grown in close proximity, which is something that would probably not happen in a home garden. It was certainly a contributing factor to the high levels of powdery mildew. But this environment also made the mildew-resistant cultivars stand out. Taxa that exhibited the best mildew resistance were 'Colrain Red', 'Marshalls Delight', 'Purple Mildew Resistant', 'Raspberry Wine', 'Rose Queen', 'Rosy-Purple', 'Violet Queen' and *M. fistulosa* f. *albescens*. The highly rated 'Marshalls Delight' became the benchmark for measuring powdery mildew resistance because of its low level of mildew infection. Although 'Purple Mildew Resistant' was completely resistant to powdery mildew, it was an inferior plant because of its susceptibility to rust.

The final determination of mildew resistance will occur in your own garden, but we can offer several recommendations to improve the performance of beebalm. Powdery mildew can be lessened by selecting mildew-resistant cultivars, increasing air movement between plants, minimizing overhead watering and removing diseased leaves each fall. Cutting stems to the ground after flowering and dividing plants every few years can further enhance plant health and vigor.

Reading List

- Hayward, G. 1983. Bee Balm. *Horticulture*. 61(7):16-19.
- Lord, T., ed. 1997. *The RHS Plant Finder 1997-98*. London: Dorling Kindersley Ltd.
- Pirone, P.P. 1978. *Diseases and Pests of Ornamental Plants*, 5th Ed. New York: John Wiley & Sons.
- Yarborough, A. 1991. *Monardas*. *Fine Gardening*. March/April. pp. 54-56.

Financial support for this publication from the Searle Research Program and the Helen V. Froehlich Foundation Research Initiative is gratefully acknowledged. A special thanks to Agriculture Canada, Research Station, Morden, Manitoba for contributing their introductions to the project, and to Mrs. Elsa Bakalar of Heath, Mass. for giving us her introduction, 'Colrain Red'. And thanks to Michael P. Harvey for his help in collecting data and photographing plants.