

Plant Evaluation Notes

An Evaluation Report of Goldenrods for the Garden

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Each autumn goldenrods adorn roadsides, native landscapes and gardens across North America. For gardeners, these bright flowers signal the end of summer and the beginning of the cool, sunny days of autumn. Goldenrods are an essential part of the autumn landscape and provide valuable late-season color in the garden.

There are almost 100 species of *Solidago* in the world, mostly native to North America. The multitude of goldenrods makes it an easily recognized group of plants, although distinguishing one species from another is not always an easy task. Complicating matters is the fact that many species hybridize naturally, creating intermediate forms that are not readily identifiable. The composite flowers of *Solidago*, made up of ray- and disk-florets, are similar to other members of Asteraceae, the aster family. Goldenrod flowers are clustered in panicles, racemes or corymbs, and except for the white ray-florets of *Solidago bicolor* are yellow or gold.

Goldenrods range in size from under a foot to more than 6 feet in height, and are herbaceous perennials that grow from either thick crowns or rhizomes. The clump-forming

goldenrods are often more desirable because species that spread by rhizomes can dominate the landscape and kill valuable garden plants. A rhizomatous species may require division every three years to keep the plants in check. Clump-forming species grow at a moderate pace and should not require division for many years.

Knowing the native habitat of a goldenrod can help in successfully cultivating it in the garden. *Solidago* species are found growing naturally in such diverse habitats as open fields, meadows and prairies; woodlands and thickets; and swamps, bogs and shorelines. Most goldenrods require full sun for best growth, although woodland species require some shade. They thrive in average garden soils but are adaptable to poorer soils, and many are drought-tolerant once established. Plants may become rampant when grown in rich garden soils.

Most goldenrods bloom from midsummer to autumn, providing a good late-season display and food for birds and insects. Many of the taller species may be “too wild” for the average gardener, but there are many shorter species and garden hybrids for sunny or shady

areas. Woodland species like wreath goldenrod (*Solidago caesia*) and zigzag goldenrod (*Solidago flexicaulis*) are great additions to the shade garden, while stiff goldenrod (*Solidago rigida*) and wrinkled goldenrod (*Solidago rugosa*) make perfect choices for the sunny border. Goldenrods combine well with other perennials including Joe-pye weeds, asters, coneflowers, gayfeathers, buddlejias and grasses.

The interest in goldenrod as a garden plant has increased over the past 10 years due in part to the shorter hybrids that were developed for the cut-flower industry in Europe beginning in the 1950s. Today the garden hybrids are more important in cultivation than any of the species. Recent American introductions like *Solidago rugosa* ‘Fireworks’ and *Solidago sphacelata* ‘Golden Fleece’ continue to renew the gardener’s interest in goldenrods. Fascination with native wildflowers and the desire to create habitats for wildlife also contribute to a further appreciation of goldenrods.

The Evaluation Project

The Chicago Botanic Garden (USDA Hardiness Zone 5b, AHS Plant Heat-Zone 5) began a five-year comparative study of *Solidago* in 1993. The project goal was to observe ornamental traits, disease and pest resistance and cultural adaptability of 25 species and garden hybrids, and to determine the best goldenrods for Midwest gardens. The inventory included taxa that were readily available at the start of the project.

Twenty-two taxa were evaluated in a primary site that normally received 10 hours of full sun during the growing season and was openly exposed to wind in all directions. The clay-loam soil was well-drained, was amended with composted leaves and had an average pH of 7.4 throughout the evaluation term. 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. The secondary site was located in a mixed landscape where all plants received natural, partial shade from nearby trees



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Solidago rugosa ‘Fireworks’

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throughout most of the day. The clay-loam soil was well-drained, was amended with organic matter and had an average pH of 7.5. All plants were sheltered from wind by fences and a collection of shrubs and trees. Three taxa were grown here, including *Solidago caesia*, *Solidago flexicaulis* 'Variegata' and *Solidago roanensis*.

Maintenance practices in both plots were kept to a minimum to simulate home garden culture. Water was provided as needed, and no fertilizer was applied. Spent flowers were not removed, and stems were not regularly cut back during the season. A mulch consisting of shredded leaves and wood chips was placed around the plants for aesthetic purposes, water conservation and weed suppression.

Observations

The goldenrods were evaluated for 1) floral display, including flower color, flower coverage and bloom period; 2) habit display, including height and width measurements, spreading potential, habit quality and foliage quality; 3) winter hardiness; 4) cultural adaptability; and 5) disease and pest resistance. Disease-free leaves and upright stems were especially important since flowering did not typically begin until August. Rust and powdery mildew contributed to the decline in

health and vigor of some goldenrods, resulting in an unfavorable display. The diverse native habitats of the species under evaluation were taken into account when monitoring the plants for cultural adaptability to an average garden soil. Plant traits and evaluation specifics are shown in Table 1. A summary rating was assigned to each taxon based on flower coverage, plant habit and health, disease and pest resistance and winter injury. A four-star rating signifies a good performance, whereas a one-star rating indicates a very poor performance. Only *Solidago bicolor*, *Solidago glomerata* and *Solidago macrophylla* did not complete three or more years of the evaluation term.

The best overall rating was received by *Solidago rugosa* 'Fireworks'. Diminutive yellow flowers were borne on curved, threadlike panicles, creating the effect of fireworks beginning in mid-September, and attracting many Monarch butterflies. The shrublike form was ornamental throughout the season, with arching stems, tight crowns and a slowly spreading habit. The sturdy stems were not pulled down by the extra weight of flowers or overhead irrigation. The fine-textured leaves emerged burgundy in spring and were dark green in summer. A small number of brown leaves were

present at the base of the stems, but 'Fireworks' usually had the least amount of leaf loss of any goldenrod. Powdery mildew was observed in 1994, 1996 and 1997, but less than 20% of the foliage was affected.

The garden hybrids 'Baby Sun' and 'Goldkind' had similar qualities and were for that reason easily compared. Both hybrids had upright, tight habits early in the summer. The stems relaxed, but rarely flopped, after flowering ended. Flower coverage was high on both hybrids, but the brown, spent flowers detracted from the ornamental display. Brown stems and spent flowers were occasionally removed to improve the general appearance of the plants. Minor levels of powdery mildew were noted in all years, and rust was observed on 'Baby Sun' in 1993 only. The lower leaves were shriveled on both cultivars by late summer each year.

The gold-mottled leaves of *Solidago flexicaulis* 'Variegata' brightened the shade garden in early summer, several months before the flowers developed. The irregular variegation ranged from speckles to streaks, but was always strongest on the spring and early summer foliage. Variegation was usually weak by late August when flowering began. The sulfur-yellow flowers were borne in the upper axils

Table 1: Plant Characteristics and Performance Summary Ratings

Overall Rating	Solidago	Flower Color	Bloom Coverage	Flower Period	Height	Width	Powdery Mildew ²	Rust ³	Winter Injury
★★	<i>altissima</i>	yellow	40 to 60%	early August - early September	59 in.	spreading	moderate	moderate	yes
★★★★	'Baby Sun'	yellow	80 to 100%	early July - mid August	27 in.	30 in.	minor	minor	no
★★★★	<i>caesia</i>	sulfur-yellow	40 to 60%	late September - mid October	28 in.	26 in.	none	none	yes
★★	<i>canadensis</i>	yellow	40 to 60%	mid September - late October	76 in.	spreading	severe	minor	no
★★★★	'Crown of Rays' (Strahlenkrone)	bright yellow	60 to 80%	late July - September	27 in.	29 in.	moderate	none	yes
★★★★	<i>flexicaulis</i> 'Variegata'	sulfur-yellow	80 to 100%	early September - mid October	54 in.	spreading	none	none	no
★★★★	<i>gigantea</i>	vivid yellow	60 to 80%	mid July - late August	40 in.	45 in.	minor	none	no
★★	'Goldenmosa'•	yellow	60 to 80%	mid August - mid September	30 in.	26 in.	moderate	moderate	yes
★★★★	'Goldkind' (Golden Baby)	golden yellow	80 to 100%	late July - September	28 in.	30 in.	minor	none	no
★★★★	<i>graminifolia</i>	yellow	40 to 60%	mid August - mid September	46 in.	spreading	none	none	yes
★★	<i>mollis</i>	yellow	<20%	late July - early September	24 in.	spreading	minor	none	yes
★★	<i>ohioensis</i>	yellow	80 to 100%	mid August - early October	24 in.	20 in.	minor	none	yes
★★	<i>patula</i>	yellow	20 to 40%	late August - early October	57 in.	30 in.	severe	none	yes
★★	'Peter Pan'•	lemon yellow	80 to 100%	mid August - mid September	38 in.	26 in.	none	minor	yes
★★★★	<i>riddellii</i>	yellow	40 to 60%	mid September - late October	33 in.	28 in.	minor	none	yes
★★★★	<i>rigida</i>	pale yellow	60 to 80%	late August - early October	62 in.	30 in.	minor	none	no
★★	<i>roanensis</i>	sulfur-yellow	20 to 40%	early September - late October	62 in.	24 in.	minor	minor	yes
★★★★	<i>rugosa</i>	yellow	60 to 80%	early October - early November	94 in.	spreading	moderate	none	yes
★★★★	<i>rugosa</i> 'Fireworks'	yellow	80 to 100%	mid September - late October	54 in.	76 in.	minor	none	no
★★★★	<i>sphacelata</i> 'Golden Fleece'	yellow	60 to 80%	late August - late October	22 in.	38 in.	none	none	no
★★	<i>squarrosa</i> •	yellow	40 to 60%	late July - late September	39 in.	24 in.	minor	none	yes
★★	<i>virgaurea</i> 'Praecox'•	vivid yellow	60 to 80%	late July - late August	50 in.	spreading	severe	moderate	yes

Overall Ratings: ★★★★★ good, ★★★★ fair, ★★ poor, ★ very poor.

¹Coverage at peak bloom, approximately 2-3 weeks after first flowers open.

²Powdery mildew level: no injury; minor= < 25% infection; severe= > 76% infection.

³Rust level: no injury; minor= < 25% infection; moderate= 26 - 75% infection; severe= > 76% infection.

•Plant completed three years of five-year evaluation term

and terminals of the wiry, zigzagged stems. The zigzag goldenrod is rhizomatous, but spreads at a moderate pace. Stems remained mostly upright to the end of summer. Plants were grown in a partially shaded site that received full sun at noon.

Solidago sphacelata 'Golden Fleece' is a compact goldenrod easily recognized by the heart-shaped basal leaves topped with airy floral sprays. Tight crowns typified the early-season habit, but centers often began to open by midsummer. The irregular growth habit was accentuated by the size differences between the basal and stem leaves. The plants began to spread at a modest rate in the third season. The floral display was not as impressive as some other goldenrods, but flowers were produced into late October and sometimes into November. No foliar diseases were observed, although chlorosis was a common problem, especially on the basal leaves.

The clump-forming stiff goldenrod, *Solidago rigida*, had bold-textured, basal leaves and tall stems with gently arching terminals. The crosier-like tips of the stems unfurled to display pale yellow flowers in flat-topped clusters, to 12 inches across. The flowers were not as abundant as other species but created a pleasant contrast to the gray-green leaves. Stems remained erect through most of the summer, but usually took on a relaxed appearance by late August. The potential for floppiness was noted, although fully flopped stems were observed in 1996 only. Powdery mildew was observed at low levels in all years, but was not considered an ornamental or health issue.

Increased disease problems and/or winter injury contributed to the fair ratings for about one-fourth of the goldenrods. The fine-textured foliage of *Solidago graminifolia* formed a billowing mass, and was totally free of rust and powdery mildew. Stems were routinely relaxed-to-floppy, but never to an unfavorable level. Flower production was fairly low for the size of the planting, and the lack of ray florets contributed to a minor floral display. Fifty percent of the plants died during the winter of 1994-95, but the remaining plants rebounded with vigorous growth in the following years. By the second year of the evaluation the plants had already spread 4 feet into the adjacent plot and turf grass, and in the fourth year had enveloped a large section of the plot, resulting in a mass 8 feet wide and 27 feet long.

Solidago 'Crown of Rays' was similar in

plant habit, size and floral character to 'Baby Sun' and 'Goldkind', but had more powdery mildew and some winter injury. The vase-shaped habit remained mostly tight and upright, although some loose, open centers were observed as the season progressed. Flower coverage was lower than the other garden hybrids, and the spent flowers reduced the ornamental impact for the remainder of the season. Withered leaves on the lower portion of the stems were also a problem. Plants were cut to the ground in 1995 only, and a secondary bloom was noted in October. Powdery mildew was observed at 50% or less in all years, and 25% of plants were killed in the winter of 1995-96.

The arching stems of *Solidago caesia* tended to be on the weak side, often relaxing to the point of falling. Wreath goldenrod was not bothered by any insects or diseases, but did suffer some damage in the first winter. Seedlings were also observed in the later years of the evaluation.

Solidago gigantea was vigorous, flowered well and was fairly resistant to powdery mildew but received a lower rating due to its inferior habit. Although its stems were not the tallest, they were among the worst for floppiness. The plants started the summer in good form, but by midseason the crowns opened and all stems eventually lodged on the ground. The stems were cut back each year in late summer, resulting in a regeneration of healthy basal leaves and a small amount of rebloom in September.

Throughout most of the season, the stems of *Solidago riddellii* were upright, with healthy, straplike basal leaves. Despite the fact that 80% of the plants died during the winter of 1994-95, the remaining plants were floriferous, with lustrous foliage and upright habits. Mildew was observed at low levels in most years.

The largest goldenrod was *Solidago rugosa*, topping out at almost 8 feet tall. Unlike 'Fireworks', the species had a spreading habit with the potential to be invasive. It flowered about two to four weeks later than 'Fireworks', and the small inflorescences seemed out of scale for a plant of its size. The small leaves were burgundy to bronze in spring and light green in summer; stems were burgundy too. Powdery mildew was moderate in most years, and the lower leaves began withering early in the summer. The amount of stem left bare by withered leaves varied from one-third to three-fourths of the height.

The remainder of the goldenrods received poor overall ratings based on higher levels of rust and powdery mildew, severe winter injury, low flower production and inferior habits. In many cases, the typical garden culture was far removed from their native environments and more than likely contributed to the inferior performance.

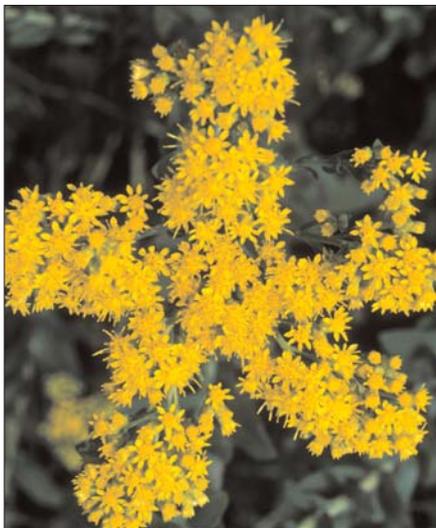
The floral display of *Solidago ohioensis* was outstanding every year. The large, flat-topped clusters of yellow flowers were typically at peak display for over two weeks. Unfortunately, the lodged stems greatly detracted from the overall display, and powdery mildew was a significant problem each year. The plants were in good health during the first two years, but only one plant survived the second winter of 1994-95.

Low flower production, rust and mildew infection, weak stems and winter damage ranging from crown injury to death of plants were the reasons *Solidago mollis* received a poor rating. *Solidago squarrosa*, a native of rocky woods, did not flourish in full sun, and it declined throughout the evaluation and eventually died during the third season. Weak stems and chlorotic or brown leaves contributed to an unsightly display.

A poor habit, including lodged stems and brown leaves, was characteristic of *Solidago* 'Goldenmosa'. Moderate levels of powdery mildew and rust, as well as crown injury in successive winters, weakened the plants until all died during the winter of 1995-96. Although good flower production and healthy, well-formed plants typified *Solidago* 'Peter Pan' during the first two years of the evaluation, almost 80% of the plants were killed during the winter of 1994-95, and the remaining plants were inferior in form and health until all died during the following year.

Solidago altissima was noteworthy for its striking, candelabra-shaped inflorescences, but was plagued each year with rust and powdery mildew, and severe winter injury in 1994-95. It spread vigorously in 1993 and 1994, but was unable to compete with the adjacent *Solidago canadensis* in later years and was ultimately overrun. *Solidago canadensis* proved to be a poor plant in cultivation. Flower production was not high, especially for the vigor of the plant; foliage was severely infected with powdery mildew and rust each year; and weak stems and a fast-spreading habit were not desirable traits for the garden.

Severe winter injury reduced the plot of *Solidago patula*, and severe powdery mildew



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Solidago rigida

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Solidago flexicaulis 'Variegata'

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Solidago 'Goldkind'

and tattered leaves diminished the ornamental display. Lodged stems and low flower production were also inferior attributes. *Solidago roanensis* was planted in the shady plots because it is native to mountain woodlands. Almost 90% of the plants were killed during the winter of 1995-96, and the remaining plants were inferior with open crowns, lodged stems, low flower production, chlorotic leaves and minor levels of rust and mildew.

Declining health due to severe powdery mildew and rust contributed to the ultimate demise of *Solidago virgaurea* 'Praecox'. Successive years of winter injury resulted in complete loss during the third winter. *Solidago glomerata*, *Solidago macrophylla* and *Solidago bicolor* were not adaptable to the conditions of the test site and died early in the evaluation project. *Solidago glomerata* declined steadily during its first season and eventually died in September. *Solidago macrophylla* died during the winter of 1994-95, after two years of declining health. *Solidago bicolor* died during the first winter, after a fair display in the first season.

Summary

In 1993, at the outset of this project, there were few cultivars of goldenrod available for evaluation in our gardens. There were numerous cultivars listed for sale in Europe and many more species offered by native plant nurseries around the country. Today, there are

more cultivars and garden hybrids for the gardener to choose from, but not all species are adaptable to cultivation or recommended for garden use.

Approximately one-fourth of the goldenrods evaluated were determined to be good garden plants with meritorious qualities of high flower production, sturdy habits and disease and pest resistance. Among the best were *Solidago* 'Baby Sun', *Solidago flexicaulis* 'Variegata', *Solidago* 'Goldkind', *Solidago rigida*, *Solidago rugosa* 'Fireworks' and *Solidago sphacelata* 'Golden Fleece'. All proved to be adaptable to general garden culture and each provided a significant ornamental display during the growing season.

The native habitat of each species determined whether the plants grew well in cultivation. The slightly droughty soil and open, sunny site were not appropriate for all goldenrods. Some of the species that grew weakly in cultivation are from native habitats with significantly different environments from the evaluation gardens, they include *Solidago bicolor* (dry, open woods), *Solidago macrophylla* (damp woods), *Solidago ohioensis* (bogs, wet prairies and shorelines), *Solidago patula* (wet woods and swamps), *Solidago roanensis* (mountain woods) and *Solidago squarrosa* (rocky woods). Conversely, *Solidago riddellii*, native to swamps and wet meadows, grew fairly well in the test site.

Powdery mildew and rust were also significant diseases that affected the health of many goldenrods, although rust was far less prevalent or damaging. The goldenrods with the highest resistance to powdery mildew included *Solidago caesia*, *Solidago flexicaulis* 'Variegata', *Solidago graminifolia*, *Solidago* 'Peter Pan' and *Solidago sphacelata* 'Golden Fleece'.

The importance of goldenrods in the late-season landscape is indisputable. Gardeners hoping to recreate a bit of nature in their landscapes would not be without them. And now with the newer, shorter cultivars available, more gardeners will be interested in adding a goldenrod for a final flash of color in the autumn garden.

Reading List

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