Research Reports

Susceptibility of Eastern Ninebark (*Physocarpus opulifolius* (L.) Maxim.) Cultivars to Powdery Mildew[1]

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Abstract

Powdery mildew disease severity was assessed on ten eastern ninebark (*Physocarpus opulifolius* (L.) Maxim.) cultivars. The green foliage cultivar 'Nanus' was resistant to powdery mildew. Among the deep purple foliage cultivars, 'Seward' Summer Wine® exhibited better resistance than 'Monlo' Diablo® and was nearly as resistant as 'Nanus'. 'Seward' Summer Wine® is a hybrid between 'Nanus' and 'Monlo' Diablo® and probably derives its mildew resistance from 'Nanus'. 'Monlo' Diablo® had reasonably good mildew resistance. Yellow foliage cultivars 'Dart's Gold', 'Morning Star' and 'Nugget', which were highly susceptible to powdery mildew, were unattractive due to substantial leaf drop, leaf disfigurement and shoot brooming. 'Luteus' exhibited better powdery mildew resistance than the other yellow foliage cultivars. 'Mindia' Coppertina® and 'Center Glow', two recent purple foliage introductions with orange-copper new foliage, exhibited levels of mildew intermediate between purple and yellow foliage cultivars. These 'Monlo' Diablo® × 'Dart's Gold' hybrids probably owe their reduced mildew resistance to their 'Dart's Gold' lineage.

Index words: disease, resistance, horticultural varieties, *Podosphaera aphanis* var. *physcarpi*, *Phyllactinia guttata*.

Significance to the Nursery Industry

Eastern ninebark (*Physocarpus opulifolius*) has enjoyed increased popularity recently due to the availability of cultivars with colorful purple and yellow foliage as well as the expanding market for native shrubs for residential landscapes. Increasingly, powdery mildew has had a detrimental impact on the aesthetics of eastern ninebark. Cultivars recommended for landscape use based on their ability to resist powdery mildew are 'Nanus' for green foliage, 'Seward' Summer Wine® for purple foliage, and 'Luteus' for yellow foliage. Cultivars with high susceptibility to powdery mildew include the yellow foliage cultivars 'Dart's Gold', 'Morning Star' and 'Nugget'. The green foliage cultivar 'Nanus' is highly resistant to powdery mildew and should be used in breeding programs to impart mildew resistance to progeny. Several purple and yellow foliage cultivars that have been introduced since this study was conducted should be evaluated to ascertain powdery mildew resistance and landscape suitability.

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Introduction

There is increased interest in eastern ninebark (*Physocarpus opulifolius* (L.) Maxim.) in the United States due to its ornamental attributes and status as a native plant. It ranges

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in eastern North America from Quebec south to Virginia and west to Tennessee, Michigan and Minnesota (4). Ornamental attributes of eastern ninebark include its spring flowering display, exfoliating bark, upright overarching habit, and orange fall color. Eastern ninebarks are adaptable landscape plants that will grow in difficult sites characterized by dry, infertile soils and full sun exposure (1). Recent introductions of cultivars with purple and yellow foliage have considerably increased the popularity of eastern ninebark. Purple and yellow foliage eastern ninebark cultivars represent comparable replacements for popular purple and yellow foliage cultivars of Japanese barberry and other invasive ornamental shrubs.

Leaf spot, powdery mildew, and to a lesser extent root and wood rot, have been reported for eastern ninebark (5). The increased use of eastern ninebark for landscaping has led to recognition of powdery mildew as a significant and potentially limiting disease of this plant in the landscape. The powdery mildew *Podosphaera aphanis* var. *physcarpi* (syn = *Sphaerotheca aphanis* var. *physcarpi*) is specific to eastern ninebark (7), however the non-specific fungus, *Phyllactinia guttata*, may also affect this plant (7). Symptoms of disease caused by these two fungal pathogens are superficial white powdery colonies on leaves, stems, inflorescences and infructescences. Witches'-brooms consisting of light pink to white colored, thickened shoots with stunted leaves are also found on eastern ninebark and are known to be caused by *P. aphanis* var. *physcarpi* (7). These brooms take on a darker color in winter due to large numbers of black cleistotheca found on the surfaces of the shoots.

Observations of landscape plants by gardeners and industry professionals suggest that differences in susceptibility to powdery mildew may exist among eastern ninebark cultivars. Powdery mildew susceptibility among eastern ninebark cultivars is not well documented because many have been introduced in recent years. As this species becomes an increasingly important landscape shrub, a better understanding of powdery mildew susceptibility is essential. Powdery mildew susceptibility among cultivars within a species has been studied for the ornamental landscape plants crapemyrtle (2), dogwood (3, 9) and delphinium (8) and for each species highly resistant or immune cultivars were identified. The goal of this study was to evaluate available eastern ninebark cultivars for their susceptibility to powdery mildew and to identify which, if any, might exhibit resistance to powdery mildew.

Materials and Methods

Container-grown eastern ninebarks were transplanted from #2 containers in May 2003 into a Paxton loamy sand on 3.7 m (12 ft) centers in rows spaced 6.0 m (20 ft) apart in full sun on the Plant Science Research Farm at the University of Connecticut, Storrs, CT (Zone 5b). The ten cultivars planted are listed in Table 1. The experimental design was a completely random design with three replications per cultivar for a total of 30 experimental plants. Plants were not provided irrigation except for immediately following planting. Directed applications of Roundup® at recommended rates were made periodically to control weeds. Weeds were hand pulled as needed. Grass alleys between the rows were periodically mowed.

During the last week of July in 2006 and 2007 plants were evaluated for powdery mildew severity using a rating scale of 0 to 5 where 0 = no disease, 1 = 1 to 20%, 2 = 21 to 40%, 3 = 41 to 60%, 4 = 61 to 80%, and 5 = 81 to 100% of the leaves, shoots, and infructescences damaged or colonized by powdery mildew. In 2006, 15 people with extensive horticultural backgrounds rated the experimental plants and in 2007, 18 people rated the plants. Ratings from all evaluators were averaged for each experimental plant. Analysis of variance using SAS (6) and the PROC MIXED procedure was performed on each year's ratings for powdery mildew and both years' ratings combined across each eastern ninebark cultivar. Differences in disease ratings among cultivars were separated with Fisher's Least Significant Difference (LSD) test.

Results and Discussion

Incidence of powdery mildew varied significantly among the cultivars of eastern ninebark (Table 2). Similar trends in disease incidence among the cultivars were observed in 2006 and 2007; however, powdery mildew ratings were slightly higher in 2007 for most cultivars. Plant replicates within a cultivar exhibited similar disease development in both study years. Powdery mildew ranged from light, where only small portions of an occasional leaf and infructescence exhibited characteristic white colonies, to heavy, where the entire surface of most leaves and infructescences were involved. Witches'-broom symptoms ranged from light or scattered shoot brooming to heavy brooming in which most shoots had brooms present.

The green foliage cultivar 'Nanus' did not develop powdery mildew symptoms in both years of the study (Table 2).

Table 1. Descriptions of eastern ninebark (*Physocarpus opulifolius*) cultivars evaluated.

Cultivar	Description
'Center Glow'	'Monlo' Diablo® × 'Dart's Gold' hybrid. Purple foliage with orange-copper new foliage. Patent No. 16,894. Patent Year 2006.
'Dart's Gold'	Older, relatively compact form with better and longer lasting yellow color than 'Luteus.'
'Luteus'	Older, large growing cultivar with yellow foliage that gradually changes to green.
'Mindia' Coppertina®	'Dart's Gold' × 'Monlo' Diablo® hybrid. Purple foliage with orange-copper new foliage. Patent No. 16,371. Patent Year 2006.
'Monlo' Diablo®	First purple cultivar discovered as a seedling in 1968 near Hamburg, Germany. Deep purple foliage. Patent No. 11,211. Patent Year 2000.
'Morning Star'	Newer cultivar with chartreuse foliage.
'Nanus'	Older cultivar with green, fine textured foliage and more compact form than the species.
'Nugget'	Newer yellow cultivar. Compact with somewhat finer textured foliage than the species.
'Seward' Summer Wine®	'Nanus' × 'Monlo' Diablo® hybrid with deep purple foliage. Patent No. 14,821. Patent Year 2004.
'Snowfall'	Selected for improved flowering and more refined habit than the species. Green foliage.

Table 2. Susceptibility of eastern ninebark (*Physocarpus opulifolius*) cultivars to powdery mildew.

Cultivar	Powdery mildew rating[z]		
	2006	2007	2006 and 2007 combined
Green foliage			
'Nanus'	0.0a[y]	0.0a	0.0a
'Snowfall'	2.8c	2.6d	2.7d
Purple foliage			
'Center Glow'	2.7c	3.1e	2.9d
'Mindia' Coppertina®	2.4c	3.1e	2.8d
'Monlo' Diablo®	2.8c	2.0c	2.2c
'Seward' Summer Wine®	1.2b	1.0b	1.1b
Yellow foliage			
'Dart's Gold'	3.9d	3.6f	3.7e
'Luteus'	2.1c	2.2c	2.2c
'Morning Star'	4.1d	4.6g	4.4f
'Nugget'	4.6d	5.0g	4.8f

[z]Severity of powdery mildew was assessed on a scale of 0 to 5 where 0 = no disease, 1 = 1 to 20%, 2 = 21 to 40%, 3 = 41 to 60%, 4 = 61 to 80%, and 5 = 81 to 100% of the leaves, stems, and fruit diseased.

[y]Means followed by the same letter are not significantly different according to Fisher's Least Significant Difference (LSD) test ($P \leq 0.05$).

'Snowball', the other green foliage cultivar, demonstrated intermediate mildew resistance as indicated by a two year combined rating of 2.7. Plants of this cultivar exhibited moderate amounts of white colonies on leaves and infructescences with some leaves completely covered and light shoot brooming.

Yellow foliage cultivars 'Dart's Gold', 'Morning Star' and 'Nugget' were highly susceptible to powdery mildew as indicated by two year combined ratings of 3.7, 4.4, and 4.8, respectively (Table 2). Highest powdery mildew incidence of 5.0 was recorded in 2007 on 'Nugget'. Widespread shoot brooming, as well as heavy colonization of leaves, infructescences and shoots, along with premature leaf drop, was observed in both years. Damage levels on these plants dramatically reduced their ornamental appeal as landscape shrubs. 'Luteus' exhibited good mildew resistance as indicated by its two year combined rating of 2.2. We observed that 'Luteus' did not retain its yellow foliage color as well as 'Dart's Gold' or 'Nugget' as has been previously reported (1). Despite poor retention of yellow color, 'Luteus' was more attractive than any of the other yellow foliage cultivars due to the greatly reduced incidence of powdery mildew.

White powdery mildew colonies were more noticeable on purple foliage plants than on yellow or green foliage plants, and may be more detracting on purple foliage plants than yellow foliage plants even if there is less of it present. Among the purple foliage cultivars, 'Seward' Summer Wine®, with a combined rating of 1.1, exhibited the best mildew resistance and was the second most powdery mildew resistant cultivar, after 'Nanus' (Table 2). On 'Seward' Summer Wine®, powdery mildew development was limited to light colonization of only a few leaves in each year. 'Seward' Summer Wine® is a hybrid between 'Nanus' and 'Monlo' Diablo® and probably derives its mildew resistance from 'Nanus'. However, 'Monlo' Diablo® also had reasonably good powdery mildew resistance, with light to moderate colonies on leaves, as indicated by its two year combined rating of 2.2. 'Center Glow' and 'Mindia' Coppertina®, with two year ratings of 2.9 and 2.8, respectively, exhibited intermediate powdery mildew susceptibility. Symptoms included moderate to heavy colonization of the leaves and light shoot brooming. These cultivars are both hybrids between 'Monlo' Diablo® and 'Dart's Gold' and their reduced mildew resistance, below that of 'Monlo' Diablo®, can probably be attributed to their 'Dart's Gold' lineage and its relatively high mildew susceptibility.

The eastern ninebark cultivars we recommend for landscape use, based on their resistance to powdery mildew, are 'Nanus' for green foliage, 'Seward' Summer Wine® for purple foliage and 'Luteus' for yellow foliage. 'Dart's Gold', 'Morning Star' and 'Nugget' proved highly susceptibile to powdery mildew and fungicide treatments would be required to maintain shrub appearance in the landscape. Several new purple and yellow foliage eastern ninebark cultivars have been introduced in recent years (not evaluated here) and additional new compact or dwarf purple and yellow foliage cultivars are in development. Given the potential of eastern ninebarks to develop severe and limiting powdery mildew, it would be valuable to landscapers, nursery growers and consumers if all new cultivars were screened to ascertain their resistance to powdery mildew. Researchers working to breed new cultivars of eastern ninebark should consider using the highly powdery mildew resistant 'Nanus' as a parent to provide resistance to powdery mildew.

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