Pruning of Meadowsweet and Steeplebush

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Summary. **Two native shrubs, meadowsweet (*Spiraea alba*) and steeplebush (*Spiraea tomentosa*), are currently grown for use in habitat restoration. Pruning could improve their form and encourage use in more formal gardens. Two seedling populations of each species were grown in the field or in containers outdoors. In Mar. 2009, plants were pruned to 3 or 15 cm or were left unpruned. By midsummer, there was no effect of pruning on plant height in field-grown plants. However, pruning did eliminate lateral growth in field plants and, therefore, improved overall form of the plants. Meadowsweet pruned to 3 cm had about half as many inflorescences as did meadowsweet pruned to 15 cm, with unpruned plants producing an intermediate number of inflorescences. Pruning container plants to 3 cm resulted in plants that were about half the height of unpruned plants, and total biomass was greatly reduced. In general, plants that were pruned had fewer inflorescences, although the total number of inflorescences in all plants was small. Pruning resulted in lower quality plant form in container plants. Species and seed sources within species responded similarly to pruning. Based on the data collected in this study, newly planted meadowsweet and steeplebush should be pruned to achieve good form in the first year. Despite the sometimes leggy growth habit in containers, these species should not be pruned before growing out in the spring, or maximum growth and good form will not be attained.**

Native plants are a potential source of new plants for managed landscapes. There is interest in gardening with natives not only for their novelty, but also to take advantage of their adaptation to local climates, to reflect regional differences, and to foster a connection with nature (West, 2001). Native plants can also be grown as an alternative to potentially invasive exotic landscape plants. Consumers are willing to pay premium prices for an attractive garden featuring native plants (Helfand et al., 2006).

The shrubs meadowsweet and steeplebush are native to eastern North America, and can be found growing from the Gulf States into Canada (U.S. Department of Agriculture, 2007). Meadowsweet and steeplebush grow to be 1 to 1.5 m tall and equally as wide. They produce long-lasting terminal inflorescences on their vertical stems from mid-June (meadowsweet) and mid-July (steeplebush) through August in the upper midwestern U.S. (Swink and Wilhelm, 1994). Meadowsweet produces white flowers and steeplebush has pale pink flowers. Both species send up numerous basal stems, with little branching. Meadowsweet is thicket forming (Meilleur et al., 1997). Meadowsweet has also been found to be highly attractive to insects that prey upon or parasitize insect herbivores (Fiedler and Landis, 2007).

Steeplebush was used in the landscape as early as 1736 (Symes, 1983), and meadowsweet and steeplebush have potential as landscape plants. Today, both species are used primarily in habitat restoration and less intensively managed areas where growth form is relatively unimportant. If they are to be used in more formal landscapes, it is important to know how to manage them for optimal growth, form, and flowering.

Meadowsweet and steeplebush produce summer flowers from new growth. Catchpole (1963) gives recommendations for pruning japanese spirea (*Spiraea japonica*), margitae spirea (*Spiraea* ×*margaritae*), and menzie's spirea (*Spiraea douglasii* var. *menziesii*), all of which have similar growth and flowering habits to meadowsweet and steeplebush. Catchpole (1963) recommended that plants be pruned to ground level in April to promote the growth of new, flower-bearing shoots. If they are not pruned, they accumulate dead wood, and flowering is reduced. Pruning them to half-height still encourages new growth but allows the development of a larger plant. To date, however, there are no similar published reports or recommendations on pruning strategies for meadowsweet or steeplebush.

Pruning could eliminate apical dominance, resulting in shrubs with more branches and thus a fuller, more attractive appearance. Because the inflorescences of meadowsweet and steeplebush form on the stem tips, increasing the number of branches could also increase the number of flowers.

Meadowsweet and steeplebush can tolerate mowing (White, 1955). In Quebec, when established plants of steeplebush were mown before spring growth was initiated, they grew 30 cm by late July (Hay, 1958), indicating that these species might respond well to severe pruning.

These species tend to have asymmetrical, lateral growth in the nursery. If these plants are to be sold in retail nurseries, this appearance would likely deter consumers from purchase. If pruning after 1 year could improve plant appearance, these species might be more suitable for retail sales. Likewise, recommendations for

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.3048	ft	m	3.2808
3.7854	gal	L	0.2642
2.54	inch(es)	cm	0.3937
16.3871	$inch^3$	cm^3	0.0610
28.3495	oz	g	0.0353
(°F – 32) ÷ 1.8	°F	°C	(1.8 × °C) + 32

early development of plant form in the landscape might make these plants more attractive to landscapers and homeowners. To determine suitable pruning-management strategies for young meadowsweet and steeplebush, plants in containers and the field were pruned to various heights, and the resulting growth, form, and flowering of the plants were measured.

Materials and methods

Field experiment. All plants used in the experiments were supplied as 15-inch^3 plugs grown by commercial nurseries from seeds germinated in Spring 2008. Seeds of both species were collected by the nurseries in Will County, IL, and Jackson County, MI (hereafter IL and MI, respectively). Both seed sources of each species were used in the container experiments, but only the IL source of steeplebush was used in the field experiment.

The experiment was conducted at the Meigs Farm of the Throckmorton Purdue Agricultural Center in Tippecanoe County, IN (lat. 40.29 °N, long. 86.88 °W). The soil type was Drummer (silty clay loam) with a pH of 6.9.

Plugs were planted on 28 Oct. 2008, and they were pruned on 24 Mar. 2009. On 8 Apr. 2009, they were fertilized with 12 g of 22N–2.2P–5K 4- to 5-month controlled-release fertilizer with micronutrients (2.6 g of N; Scotts, Marysville, OH). They were irrigated with drip tape as needed throughout the summer. Weeds were controlled mechanically.

The experiment was designed as a two-way factorial arrangement on a randomized complete block. Each of eight blocks contained one plant of each species, seed source, and pruning treatment combination. The pruning treatments were: unpruned (control), pruned to 15 cm aboveground level, and pruned 3 cm aboveground level. The field experiment was planted in two rows separated by 12 ft with plants in each row spaced 4 ft apart.

Container experiment. Plants of the MI seed source of both species were transplanted into 1.5-L containers on 28 Aug. 2008 containing Premier Pro-Mix Bx/Mycorise soilless media (pH 5.2–6.2; Premier Horticulture, Rivière-du-Loup, QC, Canada). Plants from the meadowsweet and steeplebush IL seed sources were transplanted into 1.5-L containers on 11 Oct. 2008. The containers were overwintered outside under mulch to a depth of at least 5 cm above soil level. The plants were pruned 3 cm above media level or left unpruned as a control. Pruning was done on 24 Mar. 2009 immediately after removing mulch from the containers. Two weeks after pruning, 7 g of the 22N–2.2P–5K fertilizer (1.5 g of N) was applied to each container. The plants were irrigated by hand as needed.

The experiment was a two-way factorial arrangement on a randomized complete block design with 12 blocks. Each block contained two pruning treatments applied to plants of both seed sources of both species.

Measurements. Growth, flowering, and form ratings were collected for both experiments from 2 to 4 June and 20 to 24 July 2009. By early June, most of the plants had produced vigorous spring growth, but few had begun flowering. July measurements were conducted when plants had attained their full size for the growing season and were blooming.

Height was determined as the vertical distance from the soil (field) or media (container) level to the tallest living part of the plant. For the field experiment, plant width was measured in north-south and east-west axes, and the average was taken.

Inflorescences on container-grown plants were counted in July, before biomass collection. All inflorescences, including those that were post-anthesis, were counted in Sept. 2009 to determine the total number of inflorescences produced during the growing season.

The quality and form of each plant was rated in June 2009. Plants were rated on a scale of 1 to 4 according to size (small or large plants) and symmetry (symmetrical or asymmetrical). The scale used to rate the plants was categorical, but the evaluations were based on typical nursery standards for deciduous shrubs (American Nursery and Landscape Association, 2004), with 1 = an asymmetrical plant with few shoots, 2 = a symmetrical plant with few shoots, 3 = a small asymmetrical plant with vigorous shoots, and 4 = a large symmetrical plant with vigorous shoots.

The aboveground biomass of container plants was collected on 24 July 2009 and was dried to a constant weight at 60 °C for determination of dry weight.

Data analysis. Data were analyzed using SAS (version 9.1; SAS Institute, Cary, NC). The significance of the differences among the treatments or seed sources was determined from analysis of variance and Tukey tests were conducted with PROC GLM. The significance of the effects of the treatments on the frequencies of form rating was determined by using Fisher's exact test in PROC FREQ.

Results

Field experiment. Meadowsweet and steeplebush produced irregular and lateral growth in the crowded conditions of the plug trays. However, when plugs were planted in the field, most of the new growth produced in Summer 2009 was vertical. Pruning to 15 or 3 cm did not affect the midseason height of plants from different seed sources of either species (Table 1). However, because much of the lateral growth was removed with pruning, the width of pruned plants was less than unpruned plants (Table 1). More of the pruned plants were characterized as symmetrical compared with plants that were not pruned (Table 2). Although the plants were smaller, they had a more compact and full appearance.

The young plants used in this study had few inflorescences over the growing season, and there was great variability within treatments. Pruning did not significantly affect the number of inflorescences produced by plants from any individual seed source (Table 1). However, when the data from the two meadowsweet seed sources were combined, the plants pruned to 15 cm produced almost twice as many inflorescences as the plants pruned to 3 cm, with the unpruned plants producing an intermediate number of inflorescences ($P \leq 0.0143$). Plants of the IL seed source of meadowsweet were shorter ($P \leq 0.0001$) and produced more inflorescences ($P \leq 0.016$) than plants of the MI seed source.

Container experiment. Plants of all species and seed sources in containers that were pruned to 3 cm produced less biomass than unpruned plants after about 4 months of growth (Table 3). By July, the height of pruned and unpruned plants of the

Table 1. Size and flowering of field-grown meadowsweet and steeplebush pruned to 3 or 15 cm aboveground or left unpruned (control) in Mar. 2009 (n = 8). Plants were grown from seed sources from Illinois (IL) and Michigan (MI).

Seed source	Pruning treatment[z]	Ht (cm)[y]	Width (cm)[x]	Inflorescences (no.)[w]
Meadowsweet				
IL	3 cm	40	26 b[v]	5.2
	15 cm	38	43 a	13.5
	Control	42	39 a	11.3
P value[u]		NS	**	NS
MI	3 cm	60	23 b	7.4
	15 cm	58	32 ab	11.4
	Control	52	37 a	7.4
P value		NS	*	NS
Steeplebush				
IL	3 cm	29	20 b	7.0
	15 cm	33	27 b	8.1
	Control	32	38 a	6.1
P value		NS	***	NS

Table 2. The percentage in each form rating category in June 2009 of field-grown meadowsweet and steeplebush plants pruned to 3 or 15 cm aboveground or left unpruned (control) in Mar. 2009 (n = 8). Plants were grown from seed sources from Illinois (IL) and Michigan (MI). Plants were placed in one of four categories according to size and symmetry.

		Small		Large		
Seed source	Pruning treatment[z]	Asymmetrical	Symmetrical	Asymmetrical	Symmetrical	
		Proportion in each form category (%)				
Meadowsweet						
IL	3 cm	33	33	0	33	A[x]
	15 cm	0	0	13	88	B
	Control	0	13	63	25	C
	P value[y]					**
MI	3 cm	0	80	0	20	A
	15 cm	0	14	57	29	AB
	Control	25	0	75	0	B
	P value					**
Steeplebush						
IL	3 cm	29	43	0	29	A
	15 cm	13	0	13	75	A
	Control	50	0	50	0	B
	P value					**

[z]1 cm = 0.3937 inch.
[y]The significance of the interaction between pruning treatment and form. The data were analyzed using Fisher's exact test to determine if there were differences among the pruning treatments in the frequencies of each form rating. ** indicates significance at $P \leq 0.01$.
[x]For each seed source, different letters indicate significantly different pruning treatments determined from pairwise comparisons of the pruning treatments (Fisher's exact test $P \leq 0.05$). The letters do not indicate ranking because the test does not indicate in what way the pruning treatments differ.

IL seed source of meadowsweet was similar, but the height of pruned plants of the other seed sources of meadowsweet and steeplebush was about half that of unpruned plants (Table 3). Plants of all seed sources produced very few inflorescences in containers, and pruning reduced the number of inflorescences even further in plants of the MI and IL seed sources of meadowsweet and steeplebush, respectively (Table 3). The container-grown plants tended to be asymmetrical, but the unpruned plants tended to be larger than the pruned plants (Table 4). Because of the more asymmetrical growth of container plants compared with field plants (Tables 2 and 4), width was not measured in these plants.

Discussion

Plants from two seed sources of meadowsweet and steeplebush were grown in containers and in the field and were pruned to various heights to determine the effects of early spring pruning on growth, form, and flowering. The growth and form of control plants in these experiments was, in large part, due to their growth patterns in the plug trays in which they were produced in 2008. Growth of meadowsweet and steeplebush in plug trays is often asymmetric and not upright (personal observations of the authors and several growers). This may be due to poor light penetration, leading to weak stems that lodge particularly when inflorescences are formed. Production of fuller, more symmetrical plants in containers and in the landscape may lead to greater retail sales and landscape use.

When young meadowsweet and steeplebush plants were pruned to 15 cm before planting in the field, much of the initial asymmetric and lateral growth was eliminated, resulting in a more symmetrical plant at the beginning of the growing season. The irregular shape of the previous season's growth was also eliminated when the plants were pruned to 3 cm, but many basal, vegetative buds from which new growth could have emerged were also removed.

Plants pruned to 3 cm in containers were smaller than unpruned plants throughout the growing season. This may be because the container plants were grown in an area with only morning full sun, because we observed that shading can reduce the growth of meadowsweet and steeplebush. In the container experiment, only plants of the IL seed source of meadowsweet grew to the same height as control plants in about 3 months (Table 3). Plants in the field experiment were in full sun, and growth in the pruned meadowsweet was sufficient to eliminate treatment height differences by July.

Flowers compete with vegetative growth for carbohydrates. Therefore, reproductive and vegetative growth often are negatively correlated (Kozlowski and Pallardy, 2002). Despite the pruned

Table 3. Size and inflorescence production in July 2009 in container-grown meadowsweet and steeplebush plants that were pruned to 3 cm above media level or left unpruned (control) (n = 12). Plants were grown from seed sources from Illinois (IL) and Michigan (MI).

Seed source	Pruning treatment[z]	Ht (cm)[y]	Biomass (g)[x]	Inflorescence (no.)[w]
Meadowsweet				
IL	3 cm	42	13	0.8
	Control	49	30	1.6
	P value[v]	NS	***	NS
MI	3 cm	45	16	0.8
	Control	88	51	4.0
	P value	**	***	***
Steeplebush				
IL	3 cm	26	4	0.7
	Control	56	24	4.7
	P value	***	***	**
MI	3 cm	27	4	1.2
	Control	46	11	3.2
	P value	***	**	NS

[z]1 cm = 0.3937 inch.
[y]Vertical distance from the soil surface to the highest part of the plant.
[x]Dry weight of the aboveground biomass; 1 g = 0.0353 oz.
[w]The total number of inflorescences produced through July 2009.
[v]Probability values indicate differences among the pruning treatments within a seed source. NS, **, *** indicate not significant or significant at $P \leq 0.01$ or 0.001, respectively.

Table 4. The percentage of container-grown meadowsweet and steeplebush plants in each pruning treatment that were assigned to each form rating category in June 2009 (n = 12). Plants were grown from seed sources from Illinois (IL) and Michigan (MI). Plants were placed in one of four categories according to size and symmetry, and the percentage of plants placed in each category for a given seed source is shown.

		Small		Large	
Seed source	Pruning treatment[z]	Asymmetrical	Symmetrical	Asymmetrical	Symmetrical
		Proportion in each form category (%)			
Meadowsweet					
IL	3 cm	67	8	25	0
	Control	8	0	92	0
	**[y]				
MI	3 cm	67	0	33	0
	Control	0	0	100	0
	**				
Steeplebush					
IL	3 cm	78	11	0	11
	Control	0	0	91	9
	***				
MI	3 cm	83	8	8	0
	Control	62	8	31	0
	NS				

[z]1 cm = 0.3937 inch.
[y]The significance of the interaction between pruning treatment and form. The data were analyzed using Fisher's exact test to determine if there were differences between the pruning treatments in the frequencies of each form rating. NS, **, and *** indicate not significant or significant at $P \leq 0.01$ or ≤ 0.001, respectively.

plants starting the growing season shorter than the unpruned plants, by midsummer, there were no height differences in the field-grown plants. If the most severely pruned meadowsweet eliminated this initial height difference by directing carbohydrates toward vegetative growth rather than flowering, this could explain why the meadowsweet pruned to 3 cm had the fewest inflorescences.

However, the removal of apical dominance through pruning can cause a single shoot to produce multiple new flowering branches in primocane-fruiting blackberries (*Rubus* spp.) (Thompson et al., 2007). Meadowsweet produces flowers in a panicle on the current season's growth. An increase in the number of shoots due to the removal of apical dominance could explain why the moderately pruned meadowsweet had the most inflorescences.

The recommendation that spirea (*Spirea* spp.) that bear flowers on new growth be pruned to the ground to promote new growth and eliminate old dead wood (Catchpole, 1963) may apply more to older, larger plants than those used in these experiments. Thus, the plugs used in the field experiment all produced new growth, regardless of treatment, while having little old wood to be eliminated. Plants that have been growing in the landscape for several years may have more shoots, dead wood, and seed heads from previous seasons, leading to different pruning requirements than plants in their first season in the landscape.

Although there were significant differences in size and flowering between plants of the meadowsweet seed sources, it was still difficult to tell the seed sources apart. The differences were small enough, and the variance was great enough that they appeared similar, especially when compared across pruning treatments.

In conclusion, pruning of meadowsweet and steeplebush can improve form. Most healthy plants recover from being pruned to 3 cm, but we do not recommend this in the first year after planting because it significantly reduces size and flowering.

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