Influence of Spacing on Yield of *Buddleia* and *Salix* Grown as Cut Flowers and Stems[1]

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Abstract

Plants of *Buddleia davidii* 'Black Knight' were planted on 165, 80 or 45 cm (5.5, 3 or 1.5 ft) centers in September 1991 and plants of *Salix alba* 'Britzensis' , *Salix* x *erythroflexuosa* 'Scarlet Curls' and *Salix chaenomeloides* were planted on 90, 60 or 30 cm (3, 2 and 1 ft) centers in April 1991. Stems of all taxa were harvested for three years. The number of harvested stems per plant decreased but the number of stems/m^2 increased with increasing plant density in all taxa. No significant differences in stem length or stem diameter occurred except with *Salix alba* 'Britzensis' in which the longest stems occurred at the highest density, regardless of year of harvest.

Index words: butterfly-bush, specialty cut flowers, willow.

Significance to the Nursery Industry

This study provides evidence on how plant spacing influences the yield of commercial cut flowers and stems. Plant spacing clearly has a significant influence on yield, expressed either on a per plant or area basis. The use of these taxa in the cut item trade provides additional diversity for grower, wholesaler, and florist.

Introduction

The specialty cut flower industry is based on diversity of plant material. Florists rely on growers to produce annual, perennial, bulbous and woody taxa for use as cut stems and flowers. The diversity of taxa used for cut flowers has been reviewed by Armitage (3) and research in the area of specialty crops continues in numerous locations in the United States and abroad. The use of woody species for cut flowers has been slowly adopted by growers and potential plants useful for cut stems and flowers were discussed by Dirr (5). Yield of field flowers is influenced by environmental inputs such as rainfall, temperature and photoperiod (2, 7, 10), and cultural techniques such as fertility (4, 6) and spacing (1). Spacing influences the number of flowers and overall quality of many cut flower crops. Dense spacing is used to increase the number of pots on the bench or plants in the bed, however, tight spacing can result in loss of quality due to poor air circulation and competition for light, water and nutrients. Low density spacing is recommended for many pot crops to increase lateral breaks and overall quality. In cut flowers, similar results have been found (2, 8).

Buddleia davidii French., butterfly-bush, is native to China but is naturalized in areas of the western United States and throughout the United Kingdom. Many cultivars are available and are mainly used as landscape shrubs. The flowers are formed in many-flowered panicles at the terminal of each branch. Roots are hardier than top growth (5) and survive to USDA plant hardiness zone 5 (9). 'Black Knight' is an exceptionally prolific cultivar with deep violet-purple flowers and grows to 2–3 meters (6–9 ft) in a single season.

The genus *Salix* L. contains about 300 taxa, a number of which are used in the specialty cut flower industry for contorted stems (*S. matsudana* G. Koidz. 'Tortuosa'), colorful stems (*S. alba* L. 'Vitellina') or for their decorative male catkins (*S. discolor* Muhlenb., *S. caprea* L.). In general, they tolerate extremes of soil and climate and cut stems have been harvested from plants grown as row crops and plants used for control of erosion and chemical runoff from agronomic crops into waterways (11). Taxa recently introduced as potential cut stems or catkins are *S. alba* 'Britzensis', with orange-red straight stems, *S.* x *erythroflexuosa* 'Scarlet Curls' which produces contorted red stems and *S. chaenomeloides*, with male catkins enclosed in a glossy reddish scale adpressed to the dark stem. Plants of *S. chaenomeloides* grow 2–3 meters in a single season and catkins are produced on new growth.

Cultivars of both *Buddleia* and *Salix* have potential for cut flower production because they flower on new growth and may be cut back to the ground in the fall. Thus, they do not produce significantly greater volume or height from one year to the next and may be treated similarly to herbaceous perennials.

The objective of this work was to determine the influence of spacing on yield and stem quality (as measured by stem length and stem diameter) of *Buddleia davidii* 'Black Knight', *Salix alba* 'Britzensis', *S.* x *erythroflexuosa* 'Scarlet Curls' and *S. chaenomeloides* over a three year period.

Materials and Methods

Plants of *Buddleia davidii* 'Black Knight' were rooted in the summer of 1991 and planted in the University of Georgia cut flower trial area (1) in September 1991. Plants were selected for uniformity and then planted at 165, 80 or 45 cm centers (approximate plant densities of 0.4, 1.5 or 5.0 plants/m^2). Rows were approximately 90 cm (3 ft) wide. Stems were harvested during the summer from 1992 to 1994. Plants of all *Salix* taxa were rooted in the winter of 1991 and planted in April 1991. Uniform plants of each taxon were selected and planted at 90, 60 or 30 cm plant centers (approximate plant densities of 1.2, 2.8 and 11 plants/m^2). Stems were harvested in the winters of 1992 through 1994 after the foliage had abscised.

For all taxa, three replications of each density were planted and beds were randomly assigned. Plants were fertilized twice in the spring (April and May) with 500 ppm nitrogen of water soluble 20N–12.6P–16.6K (20–20–20). Plants were irrigated as needed. All taxa were cut to about 45 cm (18 in)

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Table 1. Influence of plant density on stem length of *Salix alba* 'Britzensis'. Average of two years.

Plant density (pl/m²)	Stem length (cm)
1.2	65.6
2.8	68.2
11.0	82.7
Trend analysis	L*

*p = 0.05

from the ground early in each growing season (February-March). Stem length, stem diameter, yield per plant and yield/m² were calculated each year and analyzed using trend analysis (p = 0.05).

Results and Discussion

The data were consistent throughout the three years of the experiment, regardless of taxon. Stem lengths of *Buddleia*, *Salix chaenomeloides* and *S.* x *erythroflexuosa* 'Scarlet Curls' were unaffected by spacing since well over 90% of the harvested stems were greater than 90 cm long (data not shown). However, stems of *S. alba* 'Britzensis' were longer and less branched when planted more densely. Stems were more branched on plants and shorter in less densely planted treatments (Table 1). Stem diameter was not affected by plant density in any taxa (data not shown). The number of stems per plant increased in an inversely linear manner for all taxa as plant density decreased but stems per square meter increased linearly (Table 2). This is similar to other field work with *Achillea* L. and *Salvia* L. (1) but an interesting aspect of this work was the consistency of the results from year to year. In general, with herbaceous taxa, the influence of spacing decreases as plants mature, however this was not the case with the woody taxa in this experiment.

The results of these data have an important bearing on field planting of woody species for cut stems. The data show that plant density of woody species may be more important in affecting stem numbers than with herbaceous taxa, however, stem length and diameter are less affected. The yield of cut stems in these taxa is affected by spacing over many years of harvestable life, therefore, plant density needs to be carefully considered at planting.

Table 2. Influence of plant density on yield of *Buddleia davidii* 'Black Knight' and 3 taxa of *Salix*.

Production index	Plant density (pl/m²)	Year 1	Year 2	Year 3	Average
	Buddleia davidii 'Black Knight'				
Stems/plant	0.4	119[z]	155	78	117
	1.5	61	82	54	66
	5.0	43	58	47	49
Stems/m²	0.4	48	62	31	47
	1.5	92	123	54	90
	5.0	215	290	235	247
	Salix chaenomeloides				
Stems/plant	1.2	21	35	28	28
	2.8	12	18	15	15
	11.0	7	12	10	10
Stems/m²	1.2	25	42	34	34
	2.8	34	50	42	42
	11.0	77	132	110	106
	Salix x *erythroflexuosa* 'Scarlet Curls'				
Stems/plant	1.2	43	39	54	45
	2.8	20	24	28	24
	11.0	15	16	21	17
Stems/m²	1.2	52	47	65	55
	2.8	56	67	78	67
	11.0	165	176	231	191
	Salix alba 'Britzensis'				
Stems/plant	1.2	43	46	32	40
	2.8	23	32	28	28
	11.0	20	31	25	25
Stems/m²	1.2	52	55	38	48
	2.8	64	90	78	77
	11.0	220	341	275	279

[z]Data for all taxa and all years showed significant linear trends (p = 0.05).

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