Evaluation of a Sib-mated Population of *Buddleja davidii* 'White Bouquet' × *Buddleja indica* Hybrids[1]

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Abstract

A hybridization experiment to sib-cross a population of *B. davidii* Franch. 'White Bouquet' × *B. indica* Lam. hybrids was initiated in 2004 to generate a larger population of such hybrids to assess landscape potential. Large populations from the sib-mated *B. davidii* 'White Bouquet' × *B. indica* hybrids can be generated. The population was initially assessed for growth habit, leaf size, floriferousness, seed morphology, and winter hardiness. Susceptibility to spider mite damage was also noted in the population. Although these hybrids have desirable traits such as non-dehiscent fruit and ornamental foliage, further hybridization is needed to address undesirable traits such as sparse growth and flowering along with spider mite susceptibility.

Index words: butterfly bush, interspecific hybridization, parlor oak, Scrophulariaceae.

Significance to the Nursery Industry

Buddleja davidii Franch. × *Buddleja indica* Lam. hybrids have considerable landscape potential due to the intermediate oak-like leaves and non-dehiscent fruit characteristics. Results of this study suggest that large hybrid populations need to be generated in order to find a commercially acceptable plant that is short, compact, floriferous, winter hardy, and is not susceptible to spider-mite infestation.

Introduction

Many subtropical and tropical *Buddleja* L. species are underused in the landscape because they lack the winter hardiness to be utilized in temperate zones. One such example is *Buddleja indica* Lam., an African *Buddleja* species, which has received use as a house plant due to its attractive oak-like foliage (4). The leaves of *B. indica* are rounder and have deeper serrations than typically found on *B. davidii*.

It was thought that *B. indica* could be used to improve ornamental characteristics of *B. davidii*, so Lindstrom et al. (3) generated interspecific hybrids between *B. indica* and *B. davidii* 'White Bouquet' (both tetraploids). Fifteen F1 hybrids showed intermediate characteristics for fruit, seed, and leaf morphology compared to the parents. Fruit from the F1 hybrids were brownish and non-dehiscent, which is a trait shared by species in sect. *Nicodemia* (Tenore) Leeuw. The fruit of species in sect. *Nicodemia* is a fleshy berry-like capsule which contains un-winged seeds. All other sections of *Buddleja* have a dehiscent capsule with winged seeds.

From the original hybrid population, the potential for generating a population of landscape quality plants existed. The goal was to sib-mate the original population, producing

[1]Received for publication August 15, 2008; in revised form November 14, 2008.

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The *Journal of Environmental Horticulture* (ISSN 0738-2898) is published quarterly in March, June, September, and December by the Horticultural Research Institute, 1000 Vermont Avenue, NW, Suite 300, Washington, DC 20005. Subscription rate is $75.00 per year for scientists, educators and ANLA members; $120.00 per year for libraries and all others; add $25.00 for international (including Canada and Mexico) orders. Periodical postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to Journal of Environmental Horticulture, 1000 Vermont Avenue, NW, Suite 300, Washington, DC 20005.

plants that are short, compact, floriferous, winter hardy, and exhibit attractive oak-like leaf shape.

Materials and Methods

Thirty-one different sib-crosses, including reciprocal crosses, were made starting on September 8, 2004, between 01-20-501, 01-20-502, 01-20-503, 01-20-505, 01-20-509, 01-20-511, and 01-20-513 (some selections among the original population). All crosses were performed by hand under greenhouse conditions. Depending on the cross, 5 to 22 flowers were emasculated prior to anthesis using tweezers and subsequently pollinated for three days from time of emasculation. Fertilized capsules were collected as the color changed from green to brown.

For seed germination a mix of 1:1 (by vol) Fafard #2 (Portland, OR) and perlite was used. As a way to reduce algae growth, boiling water was poured over the mix until saturation. Media was allowed to cool for a few minutes before seeds were bulked and sown in 10 cm (4 in) traditional square pots. Pots were placed in a Park Seed Bio Dome (Greenwood, SC) until the seeds germinated. Seedlings were then transplanted into individual 7.5 cm (3 in) traditional square pots and placed under shade cloth in the greenhouse. Established seedlings were then transplanted into a Nu Pot 4 container (St. Louis, MO), [8.3 × 8.3 × 9.8 cm deep (3.2 × 3.2 × 3.8 in deep)] until ready to be field-planted May 16, 2005, at the Arkansas Agricultural Research and Extension Center, Fayetteville. Beginning in May 2005, plants were evaluated for growth habit, leaf morphology, date of first flowering, and flower size. Number of seeds per fruit, seed size, seed weight, and germination percent was also recorded for a few selected plants from the population. Pubescence color was also noted for all plants.

Results and Discussion

A large number of viable seeds was obtained from the 40 plus crosses that were made on at least five flowers per cross, which produced at least 30 seeds per capsule. A portion of the seeds was planted and roughly 250 seedlings germinated; however, only 230 plants were planted in the field due to space limitations. One of the first observable features of this population was the variability of leaf shape and size (Fig. 1). Leaves were opposite, simple, ovate to lanceolate, with dentate to sinulate margins similar to leaf morphology of the progeny of the original cross. Leaf length ranged from 17 up to 115 mm (0.66 to 4.5 in), while leaf width was as small as 18 mm (0.71 in) and as large as 49 mm (1.9 in), and generally fell within the range of the parents as reported by Lindstrom et al. (3). The larger leaf length is more characteristic of the longer leaves found on *B. davidii* 'White Bouquet', a parent in the original cross. The amount of serration of the leaf edges also varied tremendously within the population, which was also seen in the original population. Some leaf margins were entire while others were highly serrated.

After a month of growth, the seedlings in the field developed stems with either white or tan pubescence color. Nearly a 1:1 ratio (Chi-square = 1.47; $P < 0.05$) of white to tan pubescence, 90 and 107 plants respectively, was observed.

First flowering occurred July 14, 2005, with the majority of the plants flowering in either July or August (49 and 47%, respectively) (Fig. 2). *Buddleja davidii* can start flowering in June at this location; however, the hybrids flowered slightly later. A few plants did not flower until a few weeks before the first frost (October 25, 2005). Thirty-eight plants failed to flower, including thirty-four plants that did not establish in the field due to poor plant quality.

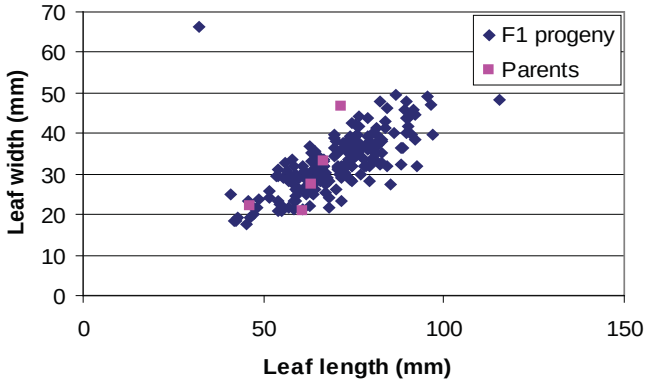

Fig. 1. Distribution of leaf length and width among 01-20 sib-mated progeny as compared with the parents.

The number of flowers per panicle varied in the population, but was typically intermediate between the parents, ranging from 18 to as many as 130 flowers per panicle (data not shown). Plants with more flowers per panicle could be selected, but it would require several years of backcrossing to generate the flower number and size typical of *B. davidii* species. Only slight differences in corolla length were seen among the population (data not shown).

Flower color was white, lavender, or pink with slight variations in between. Plants with white pubescence had white flower color, while plants with tan pubescence had either the purple or pink flower color. Flower color and pubescence color seem linked, and could provide a breeder with a quick phenotypic marker to select for flower color among a population. Tobutt (5) reported flower color could be determined on seedlings based on stem color following crosses between *Buddleja fallowiana* Balf. f. & W.W. Sm. var. 'Alba', *B. davidii* var. *nanhoensis* (Chitt.) Rehd. 'Alba', *B. davidii* 'Pink Delight', and *B. davidii* 'Royal Red'. Plants with white flowers had green stems and plants with colored flowers had stems with anthocyanin production.

The fruit did not dehisce before the first frost in Fayetteville, which is in USDA Hardiness Zone 6b/7a. The fruit on the original hybrid parents had shown similar characteristics, and though the capsules never dehisced in the field they did

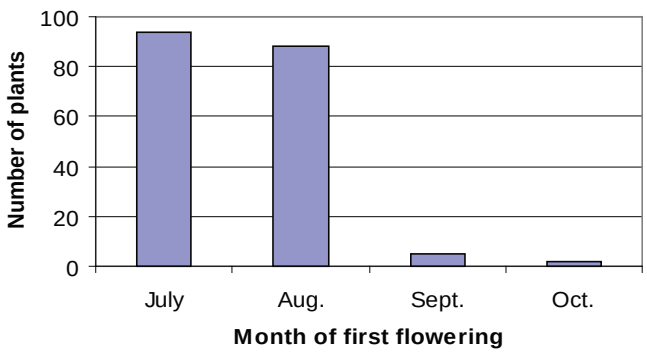

Fig. 2. Time of flowering for the sib-mated 01-20 progeny.

Table 1. Seed morphology of 01-20 sib-mated progeny selected for evaluation and compared to *B. davidii* 'White Bouquet'.

Capsule/seed characteristics	F1 progeny	*B. davidii* 'White Bouquet'
Capsule length[z] (cm)	11	13
Capsule width[z] (cm)	4	3
Seeds/capsule[z]	55	75
Capsule	non-dehiscent	dehiscent
Seed length[y] (cm)	1–3	4–5
Seed width[y] (cm)	0.5	0.25
Seed weight[w] (g)	0.012	0.004
Seed	unwinged	winged

[z]Average based on 10 fruit on each of 5 plants.

[y]Average based on 5 seeds in 10 fruit on each of 5 plants.

[w]Average based on 150 seeds.

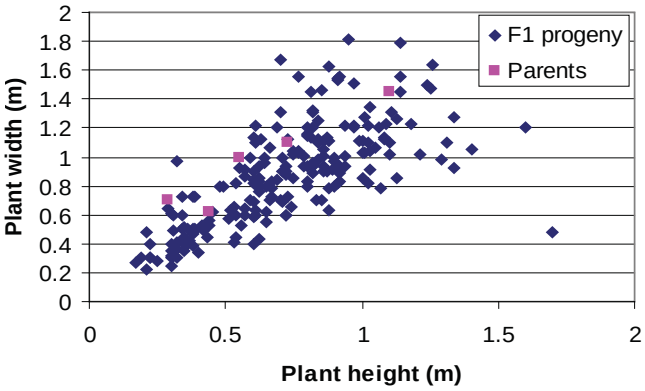

Fig. 3. Distribution of plant height and width among 01-20 sib-mated progeny as compared with the parents.

contain viable seed that germinated readily. A small germination study indicated roughly 60% germination success rate (data not shown). The hybrid population produced less seed and heavier seed than *B. davidii*, which could lessen the chance the mature seed would spread by wind (Table 1).

Not reported within the original population was the variability of growth habit in the plants, as they ranged from being quite short [0.2 m (0.6 ft)] to waist high [1.7 m (5.6 ft)] (Fig. 3). Most of the population fell in between this range. Plants that had larger stems with less branching (similar to *B. indica*) had problems with the stems splitting during high winds due to the weight of the branches before and after fruiting. Thus selection should be for plants that are small and compact.

Though *Buddleja* are reported to have few pest and disease problems, some species are susceptible to spider mites (1). Along with the original selection criteria of growth habit, plants were also evaluated for their resistance to spider mite (*Tetranychus urticae* Koch) damage. A natural population of spider mites was prevalent in the field during the first year. Most of the plant hybrids showed no symptoms; however, on plants with damage a pest gradient was seen. Some plants had some yellowing leaves with subsequent leaf drop; a few plants had 100% leaf drop. Complete leaf loss occurred more often on the dwarf, slow-growing plants. Plants that had vigorous growth, yet were susceptible to mite damage, were often missing the older lower leaves. Gillman et al. (2) reported that the less vigorous, drought-stressed plants of *B. davidii* 'Pink Delight' had greater mite damage than non-stressed plants. In another paper, Gillman et al. (1) indicated a range of susceptibility among 37 *Buddleja* species and cultivars to the two-spotted spider mite, though *B. indica* was not listed among those species. Gillman et al. (1) further stated that greater resistance to infestation was correlated to pubescent quantity, and likely chemical compounds in the leaves with both characters being heritable.

Of the original population, 34 plants had been lost due to lack of establishment, 47 plants were lost after the first winter, and another 47 plants were lost after the second winter. This is not unexpected as *B. indica* is not cold hardy in our area and some of the original plants from the *B. indica* × *B. davidii* 'White Bouquet' did not survive after the first winter; however, most of the original parent plants had survived multiple years in the field.

Selection among the population first began in 2005, and eighteen plants were selected among the population of 230 plants for additional evaluation. In 2006 and 2007 four plants were selected to remain in evaluation plots. The rest were discarded due to a combination of factors including spider mite damage and lack of winter hardiness.

When using *B. indica* in crosses, a number of undesirable characteristics can also get incorporated into the progeny such as weak branching, small panicle sizes, sparse growth habit, and perhaps greater susceptibility to spider mite damage. This suggests that large populations of hybrids are needed to effectively find a landscape quality plant. Selecting plants for spider mite resistance, restricted growth habit, abundance of flower panicles, and oak-like leaves would provide gardeners with a novel *Buddleja* hybrid. An attempt to backcross selected hybrids to *B. davidii* to increase panicle size is currently under way.

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