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Bioecology Of David's Buddleia (Buddleia Davidii), Breeding Technology

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Abstract. *Buddleja davidii* is a widespread shrub in Asia. To explore whether floral volatiles, morphological characters of flower and seed and breeding system are correlated with their distributions, we measured length and width of corolla, trichome density at corolla throat, level of stigma/anthers relationship, seed size and weight. The results indicated that these characteristics were significantly different between the two species ($P < 0.01$).
Keywords: *Buddleja davidii, Buddleja yunnanensis,* Autogamy, Xenogamy, Floral volatiles, Dust seeds.

INTRODUCTION

Buddleja davidii is a widespread plant in large areas of China. It is planted as an ornamental in many temperate countries and became a spreading weed in many of them (e.g. Clay and Drinkall, 2001; Ebeling et al., 2008; Tallent-Halsell and Watt, 2009). By contrast, the congeneric taxon *B. yunnanensis* is confined to a small area of Yunnan, China, where it grows at forest edges and thickets of the mountains (Li and Leeuwenberg, 1996). The two taxa differ in their chromosome numbers (Chen et al., 2007). In their native growing places both species are vital, but *B. yunnanensis* obviously is unable to spread vigorously. We suspected that this might result in part from reproductive peculiarities.

MATERIALS AND METHODS

Fifty randomly selected flowers from 10 plants of each species were used in taking the following measurements: length and width of corolla, trichome density on inner surface of the corolla throat obtained from 10 flowers and seed length from 50 randomly selected mature and full seeds from different individuals (10 seeds per plant). The latter two measurements were made using an Olympus light microscope equipped with ocular micrometer. In order to obtain an average seed weight, 1000 seeds of each species were weighed on an analytical balance. The pollen–ovule ratio (P/O) was estimated following Cruden (1976), using 30 randomly selected flowers from *B. davidii* and *B. yunnanensis*. To test for self-compatibility in each taxon, we used populations growing in the Kunming Botanical Garden of Kunming Institute of Botany, The Chinese Academy of Sciences (25°8^{r}48.9^{rr}N and 102°44^{r}41.2^{rr}E, 1788 m).

RESULTS AND DISCUSSION

Floral scents were investigated using the dynamic headspace adsorption method during the sunniest time of the day between 12:00 and 15:00, which coincided with the time of butterfly feeding activity. Five inflorescences of *B. davidii* and 40 of *B. yunnanensis* (approximately the same total number of flowers in each sample) were treated to compare their emission levels ($n = 3$). Newly opened inflorescences were enclosed in Tedlar bags (Dupont, USA) and volatiles were drawn from the enclosures into cartridges containing the adsorbent Porapak Q (150 mg, mesh 60/80, Waters Associates, Inc.) for 3 h, using a pump with an inlet flow rate of 300 ml min$^{—1}$. Prior to use, the adsorbent cartridges were cleaned with 2 ml of diethyl ether, dried with nitrogen gas. Trapped volatiles were eluted with 400 µl dichloromethane and concentrated to one- fifth the original volume by a gentle stream of nitrogen. 720 ng of *n*-nonane was added to each sample for quantification, and the samples were stored at —20 °C for subsequent analysis. Control samples were collected from the vegetative parts of the plant (Tedlar bags containing plants with no inflorescences).

Extracts from the inflorescences were analyzed using an Agilent Technologies HP 6890 gas chromatograph, equipped with a HP- 5MS column (30 m × 0.25 mm, 0.25 µm film thickness), and

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linked to a HP 5973 mass spectrometer. Helium was used as a carrier gas at a flow of 1 ml min^{-1}, and injector temperature was set to 250 °C. Column temperature was 40 °C and after injection, was increased to 250 °C at a rate of 3 °C min^{-1}. Compounds were identified by comparing mass spectra and retention times with those of reference compounds as well as with mass spectra in computer libraries (NIST, Wiley 7n.1.).

There is a high percentage of fruit set in open pollinated samples of both taxa. However when the flowers were covered, so that selfing was obligatory, no fruit set occurred in *B. davidii*. By contrast, in

B. yunnanensis, 76% of flowers set fruits. These results suggest that autogamy plays an important role in fruit production in *B. yunnanensis*, whereas *B. davidii* is self-sterile. This has already been pointed out by several authors (Moore, 1949; Tallent-Halsell and Watt, 2009). The proximity of the stigma to the stamens (Fig. 1e) in

B. yunnanensis can promote self-pollination and it may be that the high density of trichomes at the corolla's throat (Fig. 1g) decreases the ability of potential pollinators to penetrate inside the corolla tube. The flowers of *B. davidii* are well adapted for butterfly visitations because of their long and narrow corolla tubes with nectar guides at the throat and large production of nectar (Tallent-Halsell and Watt, 2009).

The most widely distributed species in the New World is *B. americana*, a tetraploid taxon which ranges from central Mexico through Central America to the western part of south America to northern Bolivia as well as Jamaica, Cuba and the Galapagos Islands, from sea level to 2500 m. The species is trioecious (Norman, 2000) with some plants having perfect flowers, while others only have male or female flowers. Although the flowers are very small, they have a pleasant fragrance which attracts small bees and flies. Thus in these taxa, pleasant odor, cross-pollination, self-sterility and winged seeds are associated with a large distribution.

CONCLUSION

There are probably three to four rare species of *Buddleja* in Asia and Africa, and approximately 15 in the Americas, but little is known about them. At least in America, these rare taxa are often associated with a specialized habitat. Ploidy levels do not seem to be correlated with a broad or narrow distribution pattern in this genus, although in both the Old and New World, the polyploids generally occur in mountains and at higher elevations than the diploid species (Chen et al., 2007; Norman, 2000).

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