Exploiting Variation in Boronia

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Boronias are well known for their perfume and floral displays. Plants are grown for cut flowers and ornamental plants. Cut-flower production is dominated by one cultivar of *Boronia heterophylla*, which has deep pink (red) petals. Flowering usually occurs over a short period and these factors restrict sales. The remaining natural populations of *Boronia heterophylla* in the south west of Western Australia were surveyed for new forms. A breeding program was commenced at the University of Western Australia. New cultivars with different colour forms and different flowering periods have been selected and these are undergoing further trials.

INTRODUCTION

Boronias are well known for their floral displays and sweet perfume. Boronias were originally bush picked, and picking and clearing have reduced the original populations. *Boronia heterophylla* and to a lesser extent *B. megastigma, B. serrulata, B. clavata*, and *B. muelleri* have been brought into cultivation for cut flower production. *Boronia megastigma* is also grown for oil production and a wider range of species are grown as garden plants (Plummer, 1996). Virtually all of the *B. heterophylla* grown is the deep pink ('Red') cultivar, which is harvested over a short period of about 2 weeks. Unlike *B. megastigma*, hormonal treatments do not shift the flowering period of *B. heterophylla*, and even climatic differences within the limited growing areas have little effect on flowering time (Plummer et al., 1998). A less vigorous, white-flowered form 'Moonglow' and a pale pink form 'Cameo' have been recently identified (Watkins, 1990). However, the short flowering period and limited colour range, restrict sales of both cut flowers and potted plants and this has held back expansion. Boronias also have a reputation for being somewhat difficult to propagate and short-lived in production areas and gardens. Seed germination is very low, often < 2%, and plants are usually propagated from cuttings. The aim of this research was to examine variation in flower colour, flowering period, vigour, and propagation success in the remaining populations of *B. heterophylla* and to explore the possibility of breeding boronias with new traits.

MATERIALS AND METHODS

The flower colour, flowering period, and plant vigour were recorded for 25 plants selected from each of nine natural *B. heterophylla* populations in south-western Western Australia. Most plants were selected randomly, however, unusual forms were also collected. Cuttings were collected over the summer, propagated, and the resulting plants transferred to a field plot. Flowering time, flower colour, and plant vigour were determined 2 years later. After 4 years 20 cuttings were taken from each of the remaining plants and propagation success from cultivated material was determined. Cuttings were dipped in a gel formulation of 3 mg litre^{-1} IBA (Purple Clonex™) and propagated under intermittent mist in a heated glasshouse (minimum 18C, cooled, and vented at 23C).

Hybridisation within *B. heterophylla*, using 'Red', 'Moonglow', and 'Cameo', and between *B. heterophylla* and a range of other taxa was attempted. The genotypes were *B. deanei* (pink flowers), *B. megastigma* (brown and yellow flowers), *B. megastigma* 'Lutea' (yellow flowers), *B. megastigma* 'Harlequin' (red and yellow striped flowers), *B. purdieana* (yellow flowers), *B. crenulata* (pink flowers), *B. crassipes* (pink flowers), *B. denticulata* (mauve-pink flowers), *B.* 'Telopea Valley Star' (pink flowers, *B. mollis* 5 *B. fraseri*), *B. ramosa* (blue flowers), *B.* 'Morande Candy'(pink flowers), and *B. stricta* (pink flowers). Usually fresh pollen was used but for species, which flowered at different times, pollen was collected and stored at -20C (Astarini et al., 1999). Seed were collected and embryos were removed and germinated in vitro on half-strength Murashige and Skoog (1962) medium supplemented with naphthalene acetic acid (0.1 mg litre^{-1}) and benzyladenine (0.4 mg litre^{-1}). Plants were grown in pots in a shade house for 2 years. Flower colour and flowering period were then recorded.

RESULTS AND DISCUSSION

Very few colour variants were identified during flowering in the natural populations. *Boronia heterophylla* petals do not readily abscise but fade on the bush and thus true flower colour must be observed at anthesis. This was not always possible when genotypes were observed and selected during flowering in natural stands. Only one worthy colour variant was observed in the field plot. This genotype bore pale pink flowers similar to 'Cameo' but the leaf shape and length, and plant vigour were different.

Harvest date was also very consistent with few outliers. One third of genotypes, including the 'Red' form of *B. heterophylla*, were harvested within 3 days of the mean harvest date of 24 Sept. 1996 and 72% of genotypes were within a week of this date. One genotype flowered 10 days earlier, another 20 days earlier, and two genotypes from the same population flowered 20 days later. Most genotypes (67%) had a low propagation success (< 25% strike rate). However, the proportion of cuttings producing roots varied from 0% to 100% and some easy-to-propagate (>75% strike rate) genotypes exist. The susceptibility to damping off in the misting area and subsequently in the shade house also varied between genotypes.

Hybridisation was possible both within *B. heterophylla* and between *B. heterophylla* and several species. All but one intraspecific *B. heterophylla* hybrid were red (deep pink). These included crosses with 'Moonglow' and 'Cameo' and selfed plants. One of the selfed 'Cameo' progeny had pale pink flowers of similar colour to the parents but with different leaf form. This also flowered 2 weeks earlier than 'Red' but at a similar time to 'Cameo'. Only a few of the interspecific hybrids were successfully rescued and grown to mature plants. Parents of some hybrids had a similar number of chromosomes, such as *B. heterophylla* (2n =14,15) and *B. megastigma* (2n=14), whereas others were different, such as *B. molloyae* (2n=16), *B. purdieana* (2n=18), and *B. ramosa* (2n=36) (Smith-White, 1954; Astarini et al., 1999). Hybrids between *B. heterophylla* and *B. molloyae* were all red flowered and reached harvest date at the same time as the *B. heterophylla* 'Red' parent. One hybrid between *B. heterophylla* and *B. megastigma* 'Harlequin' was more vigorous than either parent and had deep maroon petals. These flowers had a perfume similar to *B. megastigma*. None of the other hybrids had flowered.

Little natural variation exists in the petal colour and flowering period of *B. heterophylla*. This is unlike other closely-related boronias, such as *B. molloyae* and *B. megastigma*, where petal colour varies from yellow though pink or red to deep

purple or brown (Plummer, 1996). Even selfed plants with white ('Moonglow') or pale pink ('Cameo') flowers generally produced progeny with red petals. Expression and inheritance of petal colour is complex in most ornamental plants and a better understanding of pigments is required to support breeding of boronia for novel flower colour. Interspecific hybridisation showed considerable promise as a means of introducing new cultivars. Many crosses were possible even with species of different chromosome number. Flower colour within *Boronia* varies from white, through many shades of pink and red, yellow, brown, and even pale blue and this provides considerable opportunity to expand the petal colour range. Unfortunately, many of these other species are difficult to propagate and lack sufficient vigour for pot- or cut-flower production. Success in propagation varied with genotype and incorporating good strike rate along with appropriate vigour will be essential in the breeding of new boronias for pot- or cut-flower production.

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