Research Note

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Evaluation of the horticultural traits of genus *Alstroemeria* and genus *Bomarea* (Alstroemeriaceae)

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Abstract: We investigated the flower characteristics of 7 Alstroemeriaceae plants – 5 *Alstroemeria* L. species and 2 *Bomarea* Mirb. species. The flower and tepal sizes, and tepal colours were compared. The flower shape in *Alstroemeria psittacina* Lehm. was found to be similar to that in *Bomarea coccinea* (Ruiz & Pav.) Baker. The length/width ratio of *B. salsilla* (L.) Mirb. was intermediate compared with that of the other species. These preliminary data will be useful in selecting wild species in order to examine interspecific or intergeneric hybridisations in the breeding of Alstroemeriaceae plants.

Key words: *Alstroemeria*, Alstroemeriaceae, *Bomarea*, flower characteristics

Introduction

In recent years, *Alstroemeria* L. has become a popular and important cut flower species because it is available in a variety of colours and has a good vase life. There is always a demand for new cultivars of ornamental flower species, depending on the preferences of people worldwide. For example, the flowers of *Alstroemeria* exhibit particular spots on the tepal; this characteristic however does not find favour in the Japanese market. Therefore, in order to satisfy the Japanese market, Miyake (1989) introduced a breed of spotless *Alstroemeria* species without these spots on the tepal. Moreover, various cultivars have been produced by hybridisation and irradiation treatments (Broertjes & Verboom, 1974). By conducting detailed studies on interspecific hybridisation via ovule culture, Shinoda and Murata (2003) reported the possibilities and limitations of producing hybrids in 15 *Alstroemeria* species. Intergeneric hybridisation is required to produce further variations in *Alstroemeria* species and thus produce new cultivars.

It has been reported that the genera *Alstroemeria* and *Bomarea* Mirb., which belong to the family

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Alstroemeriaceae, include approximately 75 and 120 species respectively (Hofreiter & Rodriguez, 2006). Although *Alstroemeria* species have been utilised, *Bomarea* species have not been developed as a horticultural crop. Sanso and Xifreda (2001) compared both genera from taxonomic viewpoints such as subterranean organs and pollen exine. Kahraman et al. (2010) scored morphological characteristics such as corolla length and corolla colour in *Salvia* L. for a revisional study. Ishikawa et al. (1999) compared flower characteristics of *Alstroemeria* and their hybrid. In this study, the genus *Bomarea* was considered to be independent from *Alstroemeria* species. We hypothesised that *Bomarea* species showing high genetic diversity may be important generic resources and certain species such as *Bomarea salsilla* (L.) Mirb. may be useful candidates for intergeneric hybridisation with *Alstroemeria* species.

In monocotyledonous ornamental crops, the following intergeneric hybridisations have been reported: *Sandersonia aurantiaca* Hook. × *Littonia modesta* Hook. (Morgan et al., 2001) and *Sandersonia aurantiaca* × *Gloriosa rothschildiana* O'Brien (Nakamura et al., 2005). However, there is no report on intergeneric hybridisation between *Alstroemeria* and *Bomarea* species. In this study, *Alstroemeria aurea* Graham, *A. magenta* Bayer, *A. pelegrina* L., *A. ligtu* L., *A. psittacina* Lehm, *B. coccinea* (Ruiz & Pav.) Baker, and *B. salsilla* were characterised with regard to flower size, tepal size, and tepal colour. The data obtained can be used for evaluating novel hybrids of Alstroemeriaceae.

Materials and methods

Plant materials

Alstroemeria aurea, *A. magenta*, *A. pelegrina*, *A. ligtu*, *A. psittacina*, *Bomarea coccinea*, and *B. salsilla* used in this study were grown in a greenhouse at Hokkaido University.

Flower characteristics

The length, width, and depth of fully expanded flowers and the ratio of length to depth of a flower per inflorescence were measured (Figure 1). The length and width of the tepals were also measured (Figure 2). The flower colour was determined by referring to the Royal Horticultural Society (RHS) Colour Chart. The regions of the flowers that were observed for colour are indicated in Figure 3. Growth form and seed set were also observed.

Results and discussion

We found that the flowers of *Alstroemeria* L. were bigger than those of *Bomarea* (Table 1). Moreover, *Alstroemeria pelegrina* flowers were the biggest in terms of length, width, and depth. *A. psittacina* and *Bomarea coccinea* flowers were of similar length and width, and *A. ligtu* flowers were found to have greater depth than *A. aurea* flowers.

The tepals of *A. magenta* were wider than any those of the other species. All the lengths of *A. pelegrina* were the longest among all the species (Table 2). Flowers of *A. aurea* were bigger than those of *A. ligtu*, but the lengths of the tepals were shorter.

In the flowers of *A. psittacina* and *B. coccinea*, the outer tepals did not spread and form a funnel shape, whereas in *A. pelegrina*, *A. magenta* and *A. aurea*, spreading of the outer tepals was observed. The length/depth ratios in *A. ligtu* and *B. salsilla* were between those of *A. pelegrina* and *A. psittacina* (Figure 4). When the ratio was greater than 1.2, the flowers did not show a funnel shape; when it was less than 0.6, the flower showed a funnel shape in this study. It has been reported that flowers of Brazilian *Alstroemeria* species such as *A. pulchella* (syn. *A. psittacina*) are smaller and do not open as much as

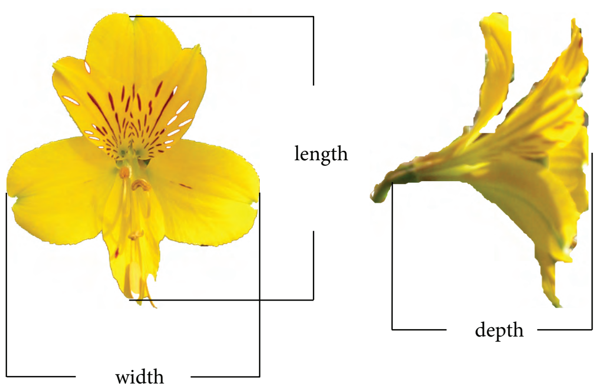

Figure 1. Representative flower structures for *Alstroemeria aurea*. Length, width, and depth were measured.

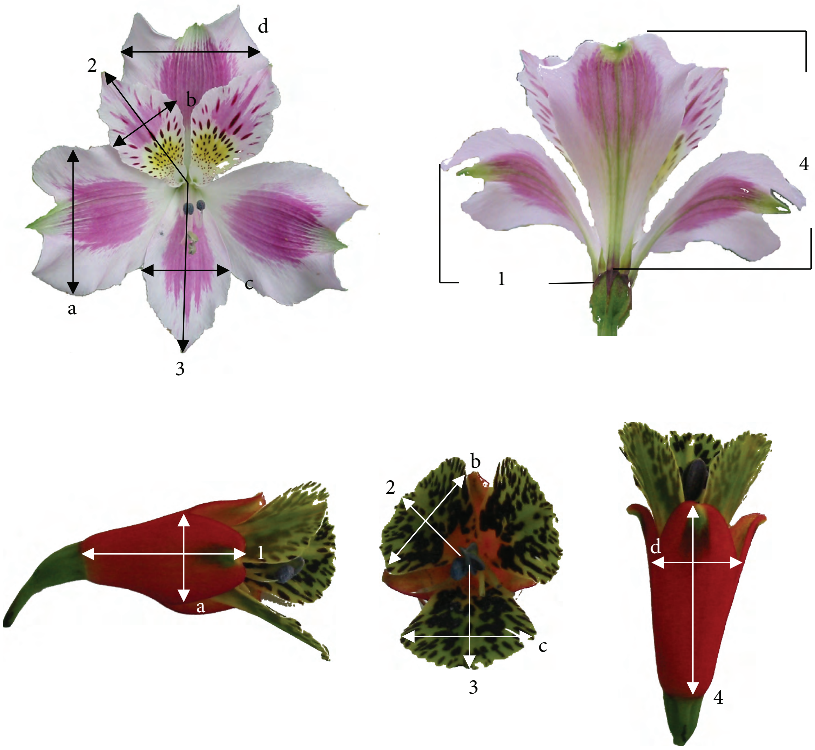

Figure 2. Representative flower structures for *Alstroemeria pelegrina* and *Bomarea coccinea*. The width was measured as a, b, c, and d. The length was measured as 1, 2, 3, and 4.

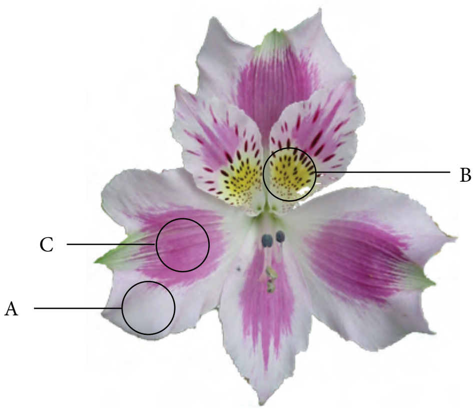

Figure 3. Tepal colour evaluated by referring to the Royal Horticultural Society Colour Chart. The flower colours at A, B, and C were evaluated as indicated.

the Chilean species such as *A. pelegrina*, *A. aurea* and *A. pulchra* (Kristiansen, 1995). While *A. aurea*, *A. magenta*, *A. pelegrina*, and *A. ligtu* are Chilean species distributed in central Chile (i.e. between 32°S and 47°S, Han et al., 2000), *A. psittacina* is a Brazilian species native to southeastern Brazil, northeastern Paraguay, and northeastern Argentina (Sanso, 1996). The ratio in *B. coccinea,* which is native to Central Peru (Hofreiter, 2006a), was similar to that in *A. psittacina*, as shown in Figure 4. The flower size of *B. salsilla* in terms of the length/depth ratio was intermediate compared to that of the other flowers (Figure 4). *B. salsilla,* which is found in central Chile, is the southernmost *Bomarea* species. There are many *Alstroemeria* species in Central Chile; however, there are no other *Bomarea* species except for *B. salsilla* (Hofreiter, 2006b).

In this study, the flowers of *Alstroemeria* species showed the following colours: red, red-purple, purple, yellow, yellow-green and yellow-orange, whereas the flowers of *Bomarea* species showed the following colours: red, red-purple, yellow-green,

Table 1. Flower size in *Alstroemeria* and *Bomarea*.

Species	Size (mm)		
	Length	Width	Depth
*A. pelegrina**	83.6 ± 4.75	76.0 ± 5.04	67.3 ± 3.45
*A. magenta**	69.9 ± 4.38	70.7 ± 4.39	57.0 ± 2.67
*A. aurea**	58.0 ± 6.14	46.7 ± 4.28	48.1 ± 3.89
*A. ligtu**	53.3 ± 4.45	44.8 ± 3.58	57.1 ± 2.02
*A. psittacina**	27.9 ± 6.48	20.7 ± 5.62	53.2 ± 2.40
*B. coccinea**	22.3 ± 1.89	18.0 ± 2.29	38.8 ± 2.36
*B. salsilla***	13.5 ± 2.88	13.5 ± 3.33	18.4 ± 1.44

*Data are expressed as the mean ± SD for 20 flowers.
**Data are expressed as the mean ± SD for 8 flowers.

Table 2. Tepal size in *Alstroemeria* and *Bomarea*.

Species	Size (mm)							
	Width***				Length***			
	a	b	c	d	1	2	3	4
*A. pelegrina**	31.0 ± 3.14	16.3 ± 1.49	18.9 ± 1.81	30.5 ± 2.65	59.6 ± 2.98	55.8 ± 2.92	55.0 ± 3.36	59.6 ± 3.20
*A. magenta**	39.1 ± 3.07	20.3 ± 0.98	22.4 ± 1.73	37.1 ± 2.74	50.2 ± 2.18	52.9 ± 3.47	40.0 ± 2.60	51.0 ± 3.25
*A. aurea**	19.1 ± 2.11	12.0 ± 1.39	11.9 ± 1.45	19.3 ± 1.81	41.3 ± 3.18	44.6 ± 3.27	42.7 ± 3.51	39.2 ± 2.88
*A. ligtu**	17.2 ± 1.39	10.1 ± 1.02	15.5 ± 1.28	15.3 ± 1.63	46.9 ± 2.29	54.2 ± 2.59	49.2 ± 3.47	42.4 ± 2.37
*A. psittacina**	10.8 ± 1.15	7.2 ± 1.09	6.2 ± 1.01	11.3 ± 0.97	40.8 ± 1.83	43.2 ± 1.40	34.3 ± 1.65	46.8 ± 1.77
*B. coccinea**	10.6 ± 1.10	13.6 ± 0.99	13.5 ± 1.54	10.6 ± 0.69	22.6 ± 1.70	32.1 ± 1.85	31.9 ± 2.41	23.5 ± 1.54
*B. salsilla***	6.0 ± 0.69	6.0 ± 0.57	5.8 ± 0.49	6.1 ± 0.61	15.1 ± 1.38	15.6 ± 1.09	16.2 ± 1.15	15.8 ± 1.38

*Data are expressed as the mean ± SD for 20 flowers.
**Data are expressed as the mean ± SD for 8 flowers.
*** Abbreviations of width (a, b, c, d) and length (1, 2, 3, 4) correspond to those in Figure 2.

and yellow-orange (Table 3). The orange-red colour that was observed in *Bomarea* was not observed in *Alstroemeria*. A study conducted in South America showed that white or green flowers tended to be smaller than flowers of other colours (Machado & Lopes, 2004). In the present study, *A. psittacina* flower, which was green, was the smallest in *Alstroemeria* (Table 3, Figure 4).

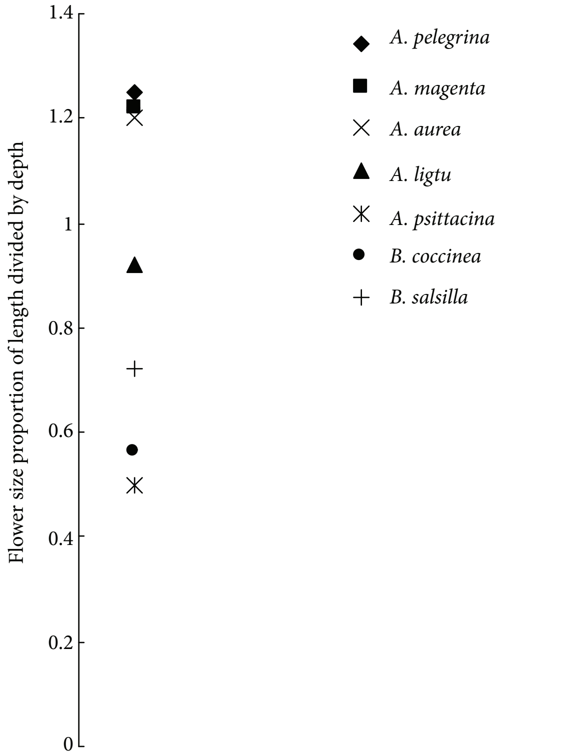

Figure 4. Evaluation of flower shape according to flower depth and length. The measurement of the ratio of length to depth is shown here.

We compared the flower tepals of *Alstroemeria* and *Bomarea* in Figure 5. The tepals of the Chilean group and the Brazilian group (*A. psittacina*) in *Alstroemeria*, and the *Bomarea* species were shown to identify the differences (Figure 5). The shape and spot pattern of Chilean *Alstroemeria* differed in the inner tepals, indicating 2 similar upper tepals and a lower distinct one. On the other hand, 3 similar inner tepals were observed in both *Bomarea* species. *Alstroemeria psittacina* was closest to the types of *Bomarea* species. The spots on the inner tepals were observed in all *Alstroemeria* species and *B. coccinea*. However, *B. salsilla* were spotless on all tepals. The flowers of *A. psittacina* showed spots on all the tepals (Figure 5). As Hofreiter and Rodriguez (2006) mentioned, it was easy to distinguish *Alstroemeria* and *Bomarea* by the different texture and shape of their inner tepals and outer tepals. We also were able to observe these differences in our study.

Bomarea showed a twining growth form, while *Alstroemeria* showed an erect growth form (Table 4). Seed sets were observed in all the species except for *B. coccinea*. In the wild, the fruits of *B. coccinea* are amphisarca, ovoid, pink and pubescent (Hofreiter, 2006a). Under the experimental conditions in this study, *B. coccinea* seeds were not formed (Table 4), although some ovaries developed after self-pollination.

Table 3. Flower colour in *Alstroemeria* and *Bomarea*.

Species	Colour*		
	A**	B**	C**
A. pelegrina	69B (Red-Purple)	7B (Yellow)	70B (Red-Purple)
A. magenta	77B (Purple)	9A (Yellow)	77B (Purple)
A. aurea	17A (Yellow-Orange)	17A (Yellow-Orange)	17A (Yellow-Orange)
A. ligtu	-	-	-
A. psittacina	149D (Yellow-Green)	144B (Yellow-Green)	46A (Red)
B. coccinea	34A (Orange-Red)	144B (Yellow-Green)	14D (Yellow-Orange)
B. salsilla	55B (Red)	59A (Red-Purple)	55B (Red)

*Royal Horticultural Society (RHS) Colour Chart number for fully expanded tepals.
**A: Edge part of lower outer tepal, B: Bottom part of upper inner tepal, C: Center part of lower outer tepal.

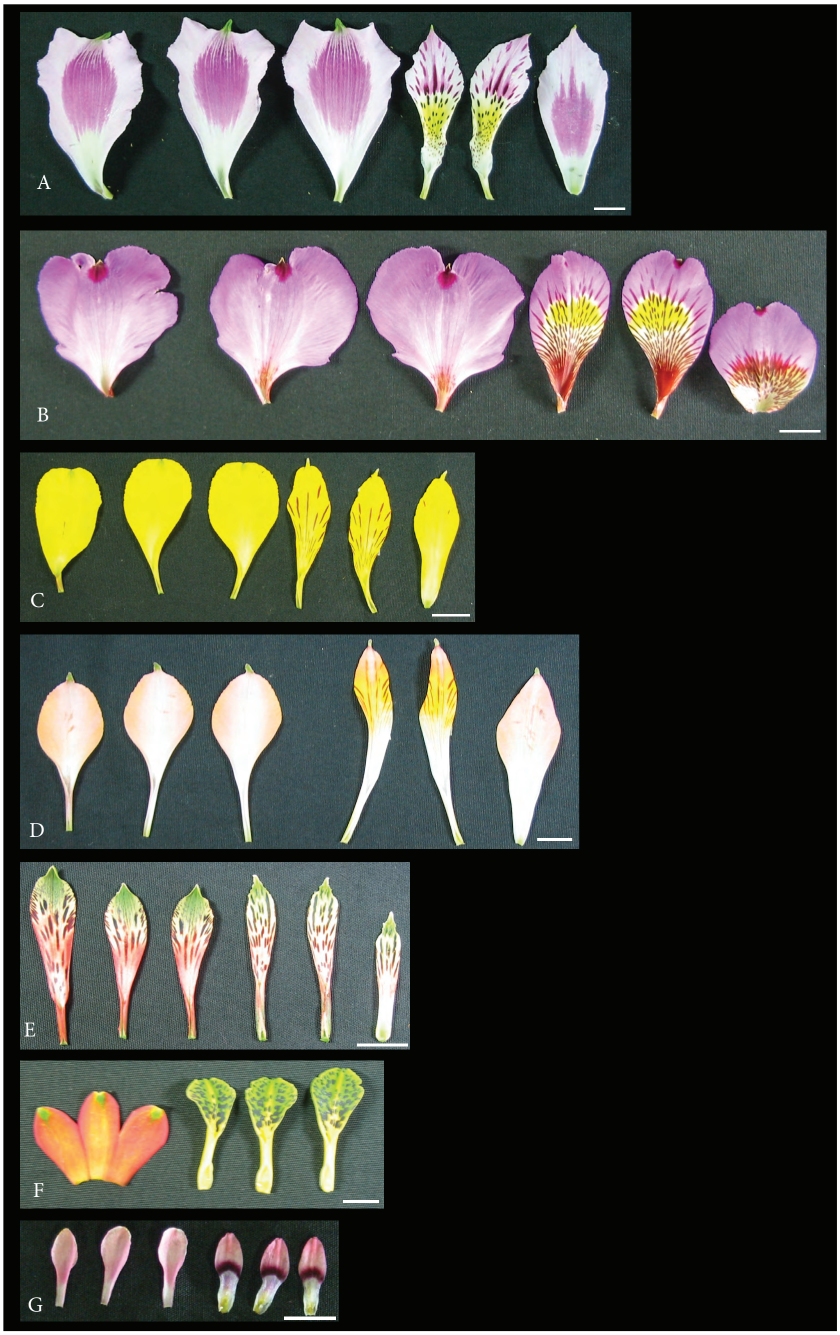

Figure 5. Comparison of the flower tepals of *Alstroemeria* and *Bomarea*. Three tepals form left and right indicated outer and inner tepals, respectively. A: *A. pelegrina*, B: *A. magenta*, C: *A. aurea*, D: *A. ligtu*, E: *A. psittacina*, F: *B. coccinea*, and G: *B. salsilla*. Scale bar = 10 mm.

Conclusion

According to Shinoda and Murata (2003), it is possible to obtain germinated interspecific embryos produced from crosses between Chilean and Brazilian *Alstroemeria* species. Thus, cross-compatibility was observed between these 2 groups, although our data showed differences in flower morphology. In the present study, we characterised 5 species of

Table 4. Growth habit in *Alstroemeria* and *Bomarea*.

Species	Characteristic	
	Growth form	Seed set
A. pelegrina	Erect	Obtained
A. magenta	Erect	Obtained
A. aurea	Erect	Obtained
A. ligtu	Erect	Obtained
A. psittacina	Erect	Obtained
B. coccinea	Weakly twining	Did not obtain
B. salsilla	Twining	Obtained

Alstroemeria and 2 species of *Bomarea*. The flower morphology of *B. salsilla* and *B. coccinea* were similar to those of Chilean and Brazilian *Alstroemeria* species respectively; however, there were certain differences between them. The data obtained may be useful for planning crosses in intergeneric hybridisation experiments.

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