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Original Article

Begonia 'Crested': A new variety of *Begonia* from interspecific hybridization of *Begonia sudjanae* C.A Janson × *Begonia puspitae* Ardi

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Abstract

Improvement of leaf shape characters in *Begonia* can be done through hybridization between two different species of *Begonia.* This study aims to produce a new variety of *Begonia* to better improve the quantitative, qualitative characters and increase its genetic diversity. The study was conducted in the green house of Bogor Botanic Gardens. Two native species of Indonesia, *Begonia sudjanae* C.A Janson as the female parent and *Begonia puspitae* Ardi as the male parent. The mature F1 seeds were sown and selections were made among the plants produced. Observation results the characteristics of the new variety *Begonia* 'Crested' as follows: stem type rhizomatous, leaves simple, ovate, peltate with strongly undulate base. Leaves margin is crenate and apex is acuminate. Colour on the upper surface are yellow green group RHS Colour Chart: (YG 144 A) strong yellow green, colour of veins on upper side is (YG 144 D) light yellow green. Inflorescence peduncle with 20 cm long branched symmetrically. The name *Begonia* 'Crested' as the selected F1 plants are propagated in a vegetative method with leaves cutting, registered on the Center of Plant Variety Protection (PPVTPP) by No. 846/PVHP/2020. This new variety is beautiful and exotic leaves ornamental *Begonia* which will be developed as commercials ornamental plants.

Keywords: *Begonia sudjanae*, *Begonia puspitae*, *Begonia* 'Crested', interspecific hybridization

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Introduction

Begonia (Begoniaceae) is one of the ten largest genera of Angiosperms, most of which have potential as ornamental foliage plants. *Begonia* has begun to be widely traded as ornamental plants, especially in pots. Native Begonias can be found in several different habitat types, such as karst, embankments or riverbanks and on the cliffs of waterfalls. Grows well in moist soil, in slightly open to shaded areas under forest stands at an altitude of 0 - 3000 m above sea level (Kiew et al., 2015).

Begonia, the only other family member is the *Hillebrandia,* a monotypic genus in the Hawaiian Islands (Wendy et al. 2004). The *Begonia* is comprised of 1968 species, is one of the largest vascular genera with a broad distribution, the centers of its diversity is in the Neo-tropics and mainland Asia, and relatively few in Africa (Neale et al., 2006). Indonesia is one of the centers of *Begonia* diversity in Southeast Asia. The number of species is now estimated to be more than 200, which are distributed from Sumatera to Papua, including small islands. The island of Java has 15 species of native *Begonia*, Sumatera has 63 species, Kalimantan 8 species, Sulawesi 57, and West Papua 70 (Hughes et al., 2015a, 2015b; Ardi et al., 2014, Thomas et al., 2012, continually updated).

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Begonia can be easily recognized by several specific character combinations, such as perennial monoecious herbs with asymmetric leaves, stipulate, unisexual flowers, petal-like sepals (tepals), centripetal stamen development, cellular calcium oxalate crystals, and seeds with a seed lid and collar cell and very little endosperm (Dewitte et al., 2011; Tebbitt, 2005). Until 2019 the Bogor Botanic Gardens have managed to collect 124 species of *Begonia* consisted of 93 Indonesian native *Begonia* species and 31 exotic species (not native to Indonesia).

Begonias are easy to hybridize by artificial pollination of different species or cultivars. Hybridization is a way of assembling genetic diversity into a better one and in a more useful form. This process, it required raw materials in the form of superior germplasm. The quality of plants produced depends on the initial superior germplasm obtained to obtain superior crop yields. An intensive effort is needed to obtain it by conducting successful breeding. Expected results are plants that have a short growth period (fast yield), resistant to pests and diseases, high production, adaptive to environmental conditions and with a long production period. In European countries many new *Begonia* hybrids were introduced (Syukur et al., 2012). *Begonia* leaves that must be considered while breeding attractive plants are the beauty of the shape and colour variations, the smoothness and firmness of the leaves, as well as the compactness of the leaf structure, durable, unique, and disease resistant.

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In subtropical countries, interspecific hybridization is carried out on *Begonia* to obtain new varieties with important agronomic characteristics in *Begonia* such as the ability to flower in winter, the shape and colour of new flowers, and resistance to pests and plant diseases (Ciolakowska et al., 2010).

In addition to the conservation activities carried out by the Botanic Gardens, efforts to sustainably utilize the *Begonia* germplasm through hybridization research are urgently needed. Some of the research that has been done at the Bogor Botanic Gardens includes taxonomic studies, morphological studies, macro propagation, phenology and attempts at artificial or breeding crosses. Artificial crosses that have been produced at Bogor Botanic Gardens produce *Begonia* 'Lovely Jo' and *Begonia* 'Tuti Siregar' which have obtained PVP Rights Requests from the Center for Plant Variety Protection and Agricultural Licensing and nine new varieties have been registered. The results of *Begonia* 'Tuti Siregar' have been able to provide broad benefits and are applied by stakeholders in Taman Bunga Nusantara (Kusuma, et al., 2019). This study aims to assemble new varieties, which has economic value, and to obtain the national certification.

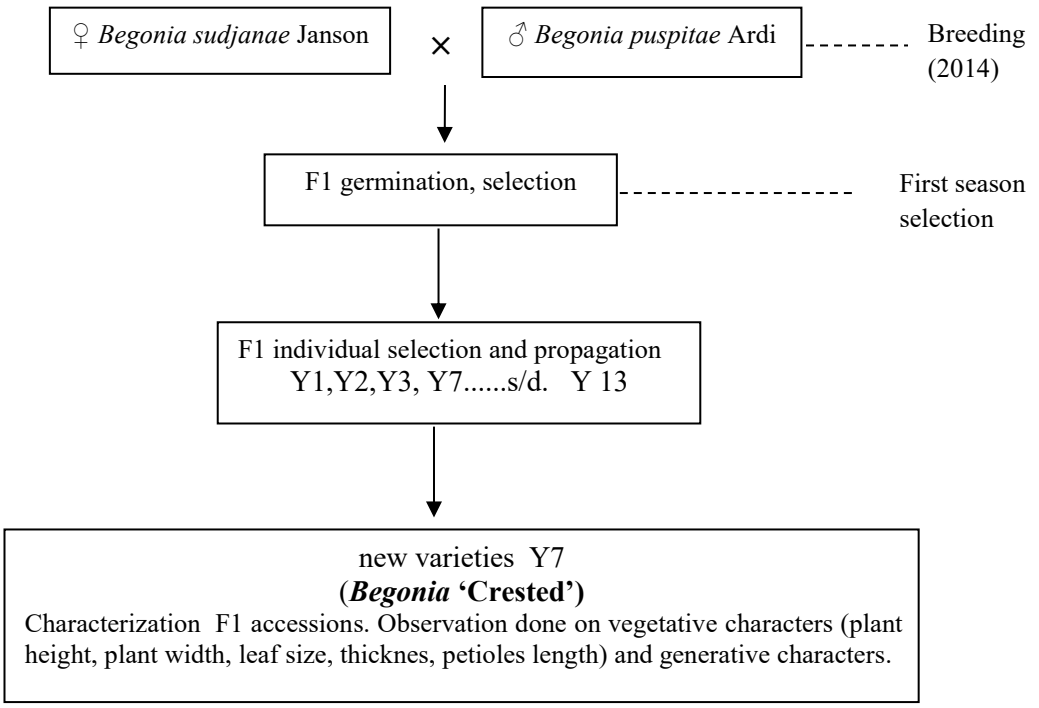

Figure 1. New *Begonia* hybrid varieties and the breeding scheme that produce them

Methods

Hybridization research uses the interspecific crossing method, which is a cross between two different species from a same genus (genetic disassortative mating). The study was conducted at green house nursery Bogor Botanic Gardens. Elevation of research site is at 250 m a.s.l., with daily temperature ranges from 28ºC−33ºC, air humidity of the greenhouse is between 60 – 90%. The genetic material used are the collections of Bogor Botanic Gardens, *Begonia sudjanae* C.A Janson as the pollen recipient (female parent) and *B. puspitae* Ardi (male parent). Breeding method is done by crossing between the two species genetic disassortative mating. Parent plants as parents must be plants that are flowering, healthy, fertile and with normal growth (Syukur et al., 2012).

Pollination is carried out in the morning at 8:00 to 11:00 am. Pollination uses tweezers that have been sterilized with 70% alcohol, when the female parent is receptive. Pollen is collected from male parent that have been synthesized in pollen containers. Next pollen is affixed to the female stigma which has been receptive. The pollinated flowers are covered with paper envelopes (or thin paper) and labeled with information on the names of the crossing parent and the date of the crossing. As a sign that the successful crossing of the flower crown will be released due to enlargement of the fruit flesh, whereas if the crossing fails the flower will fall out within 2-3 days. The fruit harvested after it has changed colour from green to brown, each fruit is placed in a separate bag and labeled. The fruit is picked and sown directly.

Artificial crosses were carried out on January 15, 2014. Five crosses were carried out and only one successded. The fruit was harvested on January 25, 2014, and seed were planted on February 25, 2014. The seeds were sown on sand media. The seeds began to germinate ten days after planting. On the 30th day after sowing, the seedlings have produced 4 leaves. The seedlings were selected four to five months after germination and transplanted into a mixed medium of rice husk charcoal and compost (2:1). The individual selection were two season of selection. The first F1 individual selection was using plant vigor as selection criteria and the second was

selected based on vigor, novelty, and unique characters. The first season selection has 65 accessions identified. The second season 13 individuals were selected. From the 13 individuals, they were re-selected to obtain F1 offspring, which were selected as the best plants with unique new characters, different from the two parents. Furthermore, the selected F1 is propagated vegetatively up to three times.

Vegetative propagation is done through leaf cuttings to multiply these superior clones. Observations were made on both the parents of *B. sudjanae, B. puspitae* and *B. sudjanae* × *B. puspitae*.

The observed characters are both of quantitative and qualitative vegetative and generatiive characters. The quantitative character namely plant height, crown width, leaf length, leaf width, leaf thickness, stem length, leaf diameter, and inflorescence: pedicel/peduncle length. The qualitative characters are characterized based on the Guidebook, Ministry of Agriculture of the Republic of Indonesia, Center for Plant Variety Protection, (2014), (Hindarwati, 2006; Maff, 2010; 2011; UPOV, 2007). Determination of colour is done by using RHS colour chart.

Results

Both of the parents are Sumatra endemic species and classified as rhizomatous stem *Begonia* and includes on *Begonia* section *Jackia* (Moonlight, et al., 2018). *Begonia sudjanae* act as the female parent and *B. puspitae* as male parent. *B. sudjanae* is originally described from the Bogor Botanic Gardens cultivated material in 1963. The cultivated material was collected from Padang, west Sumatra. *B. puspitae* was described based on cultivated material in Bogor Botanic Gardens, which collected from limestone outcrop of Batang Pangean Nature Reserve, West Sumatra (Fig. 1).

Table 1. The result of morphological characters ♀ *B. sudjanae,* ♂ *B. puspitae* and *B.* 'Crested'

No	Characteristics plant	♀ *B. sudjanae*	♂ *B. puspitae*	F1 *B.* 'Crested'
1.	Plant: stem	Rhizomatous	Rhizomatous	Rhizomatous
2.	Plant: height (cm)	Short (38.00 -50.00)	Short (30.00-35.00)	Short (28.50-34.00)
3.	Plant: width (cm)	Medium (40.00-47.00)	Medium (40.00-45.00)	Medium (50.00-60.00)
4.	Leaf blade: type	Single	Single	Single
5.	Leaf blade: Leaf blade size (cm)	(13-14 x 13-14)	(8-22 x 5-13.5)	(14-15x16-20)
6.	Leaf: thickness (cm)	Thin (0.01-0.03)	Thin (0.03-0.04)	Thin (0.01 - 0.03)
7.	Varieties with single leaf only: position of petiolar attachment	Peltate	Basifixed	Peltate
8.	Leaf blade: shape	Ovate	Ovate	Ovate, *base wavy*
9.	Leaf blade concavity	Flat	Flat	Wavy
10.	Leaf blade: base	Wavy	Cordate	Wavy
11.	Leaf blade: apex	Acuminate	Acuminate	Acuminate
12.	Leaf blade: lobation	Absent	Absent	Absent
13.	Leaf blade: margin	Serrate	Acuminate	Crenate
14.	Stipula	Triangular	Ovate	Triangular
15.	Leaf: number of colours on upper side	1	1	1
16.	Leaf blade: main colour of upper side surface	Green Group (G 138 A) Moderate Yellowish Green	Green Group (GG 137 C) Moderate Yellow Green	Yellow Green Group (YG 144 A) Strong Yellow Green
17.	Leaf blade: secondary colour on upper side	Absent	Absent	Absent

18.	Leaf blade: tertiary colour on upper side	Absent	Absent	Absent
19.	Leaf blade: distribution of secondary colour on upper side	Absent	Absent	Absent
20.	Leaf: variegation on upper side	Absent	Absent	Absent
21.	Leaf blade: width of colouration along veins on upper side	Absent	Absent	Absent
22.	Leaf blade: distribution of colouration along veins on upper side	Absent	Absent	Absent
23.	Leaf blade: colour of veins on upper side	Absent	Absent	Yellow Green Group (YG 144 D) Light Yellow Green
24.	Leaf blade: intensity of hair on upper side	Medium	Very Dense	Medium
25.	Leaf blade: main olour of abaxial surface	Green Group (G 138 C) Moderate Yellow Green	Absent	Yellow Green Group (YG 145 A) Strong Yellow Green
26.	Leaf blade: secondary colour of abaxial surface	Absent	Absent	Absent
27.	Petiole: lenght (cm)	Medium (30-32)	Medium (21-30)	Medium (14 -20)
28.	Petiole: colour	Green	Green	Green
29.	Petiole: hair	Dense	Dense	Dense
30.	Inflorescence: pedicel/peduncle length (cm)	Medium (14)	Medium (24,45)	Medium (20)
31.	Inflorescence: pedicel/peduncle colour	Green	White	White
32.	Flower: type	Single	Single	Single
33.	Male flower: colour	White Group (NN 155B) White	White Group (N 155 C) Phinkish White	White Group (N 155 C) Phinkish White
34.	Male flower: number of tepal	2	2	2
35.	Female flower: colour	2	3	2 (1)
36.	Female flower: number of tepal	Green Group (G 142 B) Brilliant Yellow Green	White Group (N 144 B) Yellowish White	White Group (N 155 B) Pinkish White
37.	Female flower: hair of tepa	Present	Absent	Absent

Discussion

Bogor Botanic Gardens has started *Begonia* hybridization program since 2011 and has successfully produced several cultivars from primary hybrid of *B. puspitae*. The first registered cultivar is *Begonia* 'Lovely Jo' (*B. puspitae* x *B. pasamanensis*), and four others cultivars are came from hybrid between *B. natunaensis x B. puspitae* (*B.*'Blirik', *B.*'Fiandani', *B.*'Green Peltate' dan *B.*'Natunapangean') (Siregar, 2016). While the hybrid between *B. sudjanae* and *B. puspitae* is here reported and named as *Begonia* 'Crested', which is derived from the undulate base forming crested (crested).

Begonia 'Crested' is a rhizomatous type *Begonia* with short internodes, plant height is (28.50-34.00) cm tall. Leaves are simple and peltate with ovate shape with undulate base, size (14-15x16-20) cm. Leaves margin is crenate and apex is acuminate. The upper surface colour is yellow green group: (YG 144 A) strong yellow green, colour of veins on upper side is (YG 144 D) light yellow green. Inflorescence peduncle with 20 cm long branched symmetrically.

Based on examination of 37 morphological characters, there are 8 different character of the new variety as shown in the Table 1. *Begonia* 'Crested' has a new character that is different from its parents: leaf blade shape ovate, base wavy, and leaf blade concavity ovate. Nevertheless, *B.*'Crested' has five common characters with its female parent: peltate leaves, undulate leaves base, serrate leaves margin, triangular stipules, and moderately covered by hairs on the upper side of the leave blades. white peduncle or pedicels, is a common character shared with its male parent.

Interspecific cross breeding between these two species of *Begonia* produced new characters at F1 hybrid. The differences between the new cultivar and its parents can be seen in the leaves shape, peltate leaves with strongly undulate base. Leaf blade concavity wavy, leaf blade base wavy, leaf blade margin crenate, stipule triangular. Leaf blade intensity of hair on upper side medium. The position of the petiole against the peltate blade with the wavy base is different from the two parents. This new hybrid is a new variety of *Begonia* with beautiful leaves and an exotic appearance. The plant's morphology / stature include a variety that is sturdy and strong and suitable as a potted ornamental plant with beautiful leaves (Fig. 2). Leaves characters heredity of this cultivars is phenotipically dominated by the female parent. Similar result reported by Siregar et al., (2018) on cultivar of *Begonia* 'Masokui', i.e. interspecific hybridization between *B. masoniana* and *B. kui* which dominated by the character of *B. kui* as female parent.

Figure 2. Morphological features of *Begonia* 'Crested' (top left), upper leaf surface (top right), leaf blade concavity wafy (bottom left), inflorescence (bottom right).

Hybridization aims to improve the quality of the plants to be produced, generally directed at improving the size, colour, content of certain materials, removing unwanted traits, being resistant to storage, and the uniqueness of these plants. Hybridization also aimed for making an increase in yield, generally directed at increasing yield component, resistance to pests and diseases as well as an unsupportive environment and vigorous plant growth. In the US Department of Agriculture, hybridization experiments were conducted on species of *Begonia* belonging to the semperflorens group, namely the species of *Begonia* that can flower continuously. This group is the most widely cultivated. Chen, et al. (2012) reported a hybrid between *B. semperflorens* species and *B.* 'Orange Rubra' with in vitro cultures. This hybrid shows different levels of mixing properties between the two parents according to the genome composition and some have the desired character of both parents. In general, *Begonia* propagation is relatively easy to do, both vegetatively and generatively. But vegetative propagation by leaf or stem cuttings is easier and faster to get results.

In conclusion, hybridization research between *B. sudjanae* as the female parent and *B. puspitae* as male parent resulted in new varieties having beautiful and unique (leaf blade shape ovate with base wavy), as well as more interesting than its parent. Named as *Begonia* 'Crested' and registered on the Center of Plant Variety Protection (PPVTPP) by No 846/PVHP/2020.

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