

Four new varieties of *Begonia* from interspecific hybridization *Begonia natunaensis* C.W.Lin & C.I.Peng × *Begonia puspitae* Ardi

HARTUTININGSIH-M. SIREGAR

Center for Plant Conservation-Bogor Botanic Gardens, Indonesian Institute of Sciences. Jl. Ir. H. Juanda No. 13, P.O. Box 309, Bogor 16003, West Java, Indonesia. Tel./fax.: +62-251-8322187. ✉email: hartutiningsih@yahoo.co.id

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Abstract. Siregar HM. 2016. Four new varieties of *Begonia* from interspecific hybridization *Begonia natunaensis* C.W.Lin & C.I.Peng × *Begonia puspitae* Ardi. *Biodiversitas* 17: 776-782. Increased phenotypic diversity of ornamental plants (e.g. *Begonia*) can often be achieved by hybridization and selection in the F1 generation. This study aimed to produce new F1 varieties which it was hoped would display improved phenotypic characteristics compared to the contributing parents. The study was conducted in the green house of Bogor Botanic Gardens. Two native species of Indonesia, *Begonia natunaensis* C.W.Lin & C.I.Peng and *B. puspitae* Ardi, were used as parent plants. The mature F1 seeds were sown and selections were made among the plants produced. The result of the selection were four new accessions of F1 plants (X1, X3, X10, X22). The selected F1 plants were then propagated vegetatively with leaf cuttings. These were named, described and registered at the Center for Plant Variety Protection (PPVTPP). This resulted in the registration of the following F1 cultivars: X1 named *Begonia* Bliirik which is registered as No. 347/PVHP/2015 and is characterized by purplish peltate leaves with bright whitish green veins, and white flowers; X3 named *Begonia* Fiandani, registered as No. 348/PVHP/2015 and characterized by dark green leaf color, corrugated leaf surface, and pink flowers; X10 named *Begonia* Green Peltate, registered as No. 345/PVHP/2015 and characterized by large green peltate leaves, and red flowers; and X22 named *Begonia* Natunapangean, registered as No. 346/PVHP/2015, and characterized by eccentrically shaped, green basifixed leaves, with ovate shape, and cordate leaf base. Thus the new varieties have been registered in PPVTPP, in accordance with legislation in force. These new varieties are beautiful ornamental *Begonia* hybrids with exotic leaves, which will be developed as commercial ornamental plants.

Keywords: *Begonia natunaensis*, *Begonia puspitae*, *Begonia* Bliirik, *Begonia* Green peltate, *Begonia* Natunapangean, *Begonia* Fiandani, interspecific hybridization

INTRODUCTION

Indonesia is a country with among the richest biodiversity in the world. More than about 280,000 species of plants are known to be native to the country. Some of the wild species have good potential as ornamental plants that can be cultivated and produced as important commercial commodities, contributing to increased national revenue. Wild ornamental plants are important genetic resources that can be used for developing a new plant variety. Therefore, an inventory of Indonesian native ornamental plants needs to be developed for selecting potential species to be used as mother plants for artificial hybridization. The aims of a cross-breeding program is to improve the quality of the plants both genotypically and phenotypically.

Begoniaceae species diversity in the world is estimated at more than 1,825 species spread in the tropics and subtropics of Asia, America and Africa (Hughes et al. 2016, Kiew 2005). Indonesia is one of the important centers of *Begonia* germplasm resources in Southeast Asia. Take Java Island for example, Java has at least 15 species of wild *Begonia*. Begonias are also found in other islands of Indonesia, such as 52 species recorded in Sumatra, 8 species in Kalimantan, 44 species in Celebes and 70 species in Irian (Smith et al. 1986). Wild Begonias generally occur in wet tropical rain forest, from lowland areas up to mountainous areas 2,400 m above sea level.

Bogor Botanical Gardens as a Center for Plant Conservation in Indonesia has the second largest *Begonia* collection in the country, second only to Bali Botanic Gardens. Bogor BG has 134 species of *Begonia*, consisting of 37 exotic species and 97 native species, while Bali BG has 313 species, consisting of 213 exotic and 100 native species. All the native species were collected from the wild during plant expeditions. Hoover (2006) declared that Bali Botanic Gardens has the most comprehensive *Begonia* collection in the world.

Horticulturally, Begoniaceae is separated into two ornamental types; flowering Begonias and beautiful leafy Begonias. The uniqueness and beauty of their leaves (i.e. their shape and color), the compactness of the plants and their vigor, and the resistance of the plant to diseases are basic characters that have to be given priority when developing a new variety of ornamental leaf *Begonia*.

Several new varieties of *Begonia* have already been created from artificial hybridization in the Botanical Gardens. The first one is *Begonia* "Lovely Jo" from the hybrid *B. puspitae* × *B. pasamanensis*. This variety has been registered and certified by the Center for Plant Variety Protection and Licensing Agriculture (PPVTPP), the Ministry of Agriculture with the registration number 00237/PPVT/S/2013. The second variety is *Begonia* "Tuti Siregar" (*B. listada* × *B. acetosa*) with the number 00 275/PPVT/S/2014: this has also been registered as a new

cultivar of the American Begonia Society with registration number 1001 (Salisbury 2008).

The next step in this research and development project is the morphological observation and characterization of additional wild species to provide a base of support for new variety development. In particular, the research should emphasize selection of parent materials that will be useful in artificial hybridization. Thus the research reported in this paper aims to identify improved quality of leaves characteristics, such as shape and coloration, in order to produce attractive and economically valuable new varieties that can be registered for plant variety protection from the PPVTPP in the Ministry of Agriculture.

MATERIALS AND METHODS

The study was conducted in the Greenhouse Nursery of Bogor Botanical Gardens, West Java, Indonesia at an altitude of 250 m asl., with a daily temperature range 28-33°C and relative humidity between 60-90% in the greenhouse. The hybridization research depended on crosses between two contrasting species (genetic disassortative mating), viz. with parent plants that had healthy growth and were capable of flowering to produce fertile, normal flowers (Syukur et al. 2012). The genetic materials used were from the Bogor Botanic Gardens collections. They consisted of *Begonia natunaensis* C.W.Lin & C.I.Peng as pollen recipient and *B. puspitae* Ardi as pollen donor. *B. natunaensis*, a recently discovered species from Natuna Island, Indonesia, has been described by Lin and Peng (2014). *B. puspitae*, an endemic of West Sumatra, was first described by Hughes et al. (2009). From crosses between the two parents, four F1 accession numbers of the interspecies *B. natunaensis* × *B. puspitae* were obtained by the following method.

Female flowers used were receptive flowers of *B. natunaensis*, at a time of blooming when the head of the stigma was ready to receive pollen. Pollen from fresh *B. puspitae* flowers were obtained at the time of anthesis. The pollen was transferred either using cotton buds or else directly from the anthers of the flowers, by smearing it onto the stigma of the recipient flowers. The recipient flowers were tagged and covered with small plastic bags to protect them from pollen contamination of unwanted species. The artificial hybridization was carried out on January 5, 2011, by crosses involving ten recipient flowers. From the ten attempted hybridizations, only one succeeded. The fruit of that one flower was harvested on February 23, 2011 and seeds were planted on 25 February. The seeds began to germinate ten days after planting. Due to the small size and uncountable number of the seedlings, the seedlings were selected four to five months after germination and transplanted into a mixed medium of rice husk charcoal and compost (2:1). From the selection, 44 accessions were identified.

Superior F1 plant individuals were selected. Then vegetative propagation was carried out on leaf cuttings to propagate clones of these selections. Observations were made on the vegetative characteristics of the clones; by measuring plant height, crown width, leaf length, leaf

width, leaf thickness, and length and diameter of petiole; observation of leaf shape, leaf base, leaf tip, leaf nicks, stipule shape, leaf color, color distribution, leaf hairs, etc.. Generative characteristics were also recorded based on observations of inflorescence, flower type, flower color, etc. Determination of color was done using a color map (color chart). F1 selection results were specified according to the guide books of the Ministry of Agriculture of the Republic of Indonesia, Center for Plant Variety Protection (2014), Hindarwati (2006) and MAFF (2010, 2011).

RESULT AND DISCUSSION

Begonia has been the subject of significant plant breeding effort in the past, as indicated by the existence of new varieties of *Begonia* both within and outside the country. Kiew (2005) and Kiew et al. (2015) have estimated that more than 10,000 hybrids of *Begonia* are known world-wide, some with good recording and others without any records. Thus efforts to produce new varieties of *Begonia* through plant breeding programs such as interspecies hybridization must have clear aims if they are to enhance the *Begonia* diversity relative to the source breeding material. The specific characters that the breeder wants to improve are sought from another variety, wild relative or species, or from the recombination of these in controlled hybridization programs. The availability of sources of genetic diversity determine the potential success of such a breeding program (Yunianti et al. 2007).

Begonia breeding programs at the Bogor Botanical Garden *Begonia* have focused on lowland species for the development of new ornamental leaf Begonias. The study reported here is one in the research program described previously by Hartutiningsih et al. (2014).

The female parent used in this study is *B. natunaensis*, a lowland species, morphologically similar to *B. goegoensis* (Tebbitt 2005). It is characterized by rhizomatous and creeping stems; green/reddish, glabrous petioles, 10-21 cm long; laminas peltate, 9-20 cm in diameter, with the upper surface bullate and brownish green in colour between bright green veins, and with red leaf margins; flowers red and small in size (Lin and Peng 2014). Figure 1 illustrates this species.

The male plant is *B. puspitae* a species endemic to West Sumatra, and only found in the karst hills of Nature Reserve Trunk Pangean I, Nagari Solok, Sawah Lunto, West Sumatra. It is characterized by a rhizomatous stem and by basifixed, green, broadly ovate leaves, with dense hairs on lower and upper surface. Its flowers are many, white and small (Hughes et al. 2009).

Hybridization requires cross-pollination, and fertilization to occur. It is indicated by wilted perianth or tepals, that drop off within three days after pollination; then followed by a swollen ovary. The fruit will ripen, change its color from green to brown, and dry within 30-45 days. The ripened fruit should be harvested as soon as possible, before the capsule opens, and should be stored in an envelope, and then seed should be extracted from it (Hartutiningsih 2008).

The results of the hybridization showed that the particular qualitative characters that are conserved (i.e. remaining similar to both parents), are type of stem, leaf type, leaf tips, edges of leaves, stipules, petiole, and flower type (Table 1). A qualitatively different character that arises is the shape of the leaves; i.e. in *Begonia* Natunapangean the leaf shape is much more similar to the male parent (*B. puspitae*), with basifixed and broadly ovate leaves. This character is different in the other three new varieties.

Another distinctive character is the color of the leaves, *Begonia* Blirik has two colors on the upper surface, while the other varieties have only one. Compared to the three other varieties, *B. Blirik* has a brighter color which is a blend of green (G137) and red green (RP 70). The primary color of the lower surface of the leaves is green reddish (RP 70 B) and the flowers are white W 155D (Table 1).

Begonia Blirik

Rhizomatous plant type, plant height (24.5 cm). Single leaf blade, peltate, the leaf base cordate, leaf shape ovate, upper surface of the leaf color green G 137 A, secondary color on upper side red RP 70 B, the color of the leaf surface green, bottom reddish RP 70 C. Flowers single, white color W 155D. Plant stature strong, suitable for beautiful leafy ornamental plants in pots. Different characteristics from the parent are the peltate leaf shape, coloration of veins on upper side bright green, and white flowers. First flowered in January 2012. The derivation of the name comes from the color green leaf with bright coloration of veins, resulting in colored stripes or "blirik". *B. Blirik* is registered by letter as No. 347/PVHP/2015 (Figure 2.A-C).

Table 1. The result of morphological characters on four new varieties of *Begonia* (*B. Blirik*, *B. Fiandani*, *B. Green Peltate* dan *B. Natunapangean*)

Characteristics plant	Expression of <i>Begonia</i>			
	<i>B. Blirik</i> (X1)	<i>B. Fiandani</i> (X3)	<i>B. Green Peltate</i> (X10)	<i>B. Natunapangean</i> (X22)
Plant: stem	Rhizomatous	Rhizomatous	Rhizomatous	Rhizomatous
Plant: height (cm)	Short (24.50)	Short (25.50)	Short (31.50)	Short (29.00)
Plant: width (cm)	Medium (28.00)	Medium (44.00)	Medium (36.00)	Medium (28.00)
Leaf blade: type	Single	Single	Single	Single
Leaf blade: Leaf blade size (cm)	Medium (11.50-16.50: 9.00-13.50)	Medium (14.50-17.50: 12.50-13.00)	Medium (16.00-22.00: 12.00-16.00)	Medium (17.00-20.00: 14.00-16.00)
Leaf: thickness (cm)	Thin (0.35)	Thin (0.55)	Thin (0.41)	Thin (0.21)
Varieties with single leaf only: Position of petiolar attachment	Peltate	Peltate	Peltate	Basifixed
Leaf blade: shape	Ovate	Ovate	Ovate	Ovate
Leaf blade: base	Absent	Absent	Absent	Cordate
Leaf blade: apex	Acuminate	Acuminate	Acuminate	Acuminate
Leaf blade: lobation	Absent	Absent	Absent	Absent
Leaf blade: margin	Crenate	Crenate	Crenate	Crenate
Stipula	Triangular	Triangular	Triangular	Triangular
Leaf: number of colors on upper side	Two	One	One	One
Leaf blade: main color of upper side surface	Green G 137 A	Green N 137 B	Green G 137 A (glossy)	Green G137 C
Leaf blade: secondary color on upper side	Red RP 70 B	Absent	Absent	Absent
Leaf blade: distribution of secondary color on upper side	Whole	Absent	Absent	Absent
Leaf: Variegation on upper side	Absent	Absent	Absent	Absent
Leaf blade: coloration of veins on upper side	Different	Different	Different	Different
Leaf blade: distribution of coloration along veins on upper side	Entire	Entire	Entire	Entire
Leaf blade: width of coloration along veins on upper side	Narrow	Narrow	Narrow	Narrow
Leaf blade: intensity of hair on upper side	Sparse	Sparse	Sparse	Sparse
Leaf blade: main color of lower side	Reddish green RP 70 B	Yellow green YG 144 C	Reddish green RP 65 C	Reddish green RP 65 C
Leaf blade: secondary color of lower side	Absent	Absent	Absent	Absent
Petiole: length (cm)	Short (14.50)	Medium (22.83)	Short (14.50)	Medium (20.60)
Petiole: color	Reddish green	Reddish green	Reddish green	Green
Petiole: hair	Sparse	Sparse	Sparse	Sparse
Inflorescence: pedicel/peduncle length (cm)	Medium (27.50)	Medium (21.50)	Medium (36.00)	Medium (21.50)
Inflorescence: pedicel/peduncle color	Reddish green	Reddish green	Reddish green	Reddish green
Flower: type	Single	Single	Single	Single
Flower: color	White W 155D	Pink RP 69 A	Red RP 62 B	Red RP 62 C

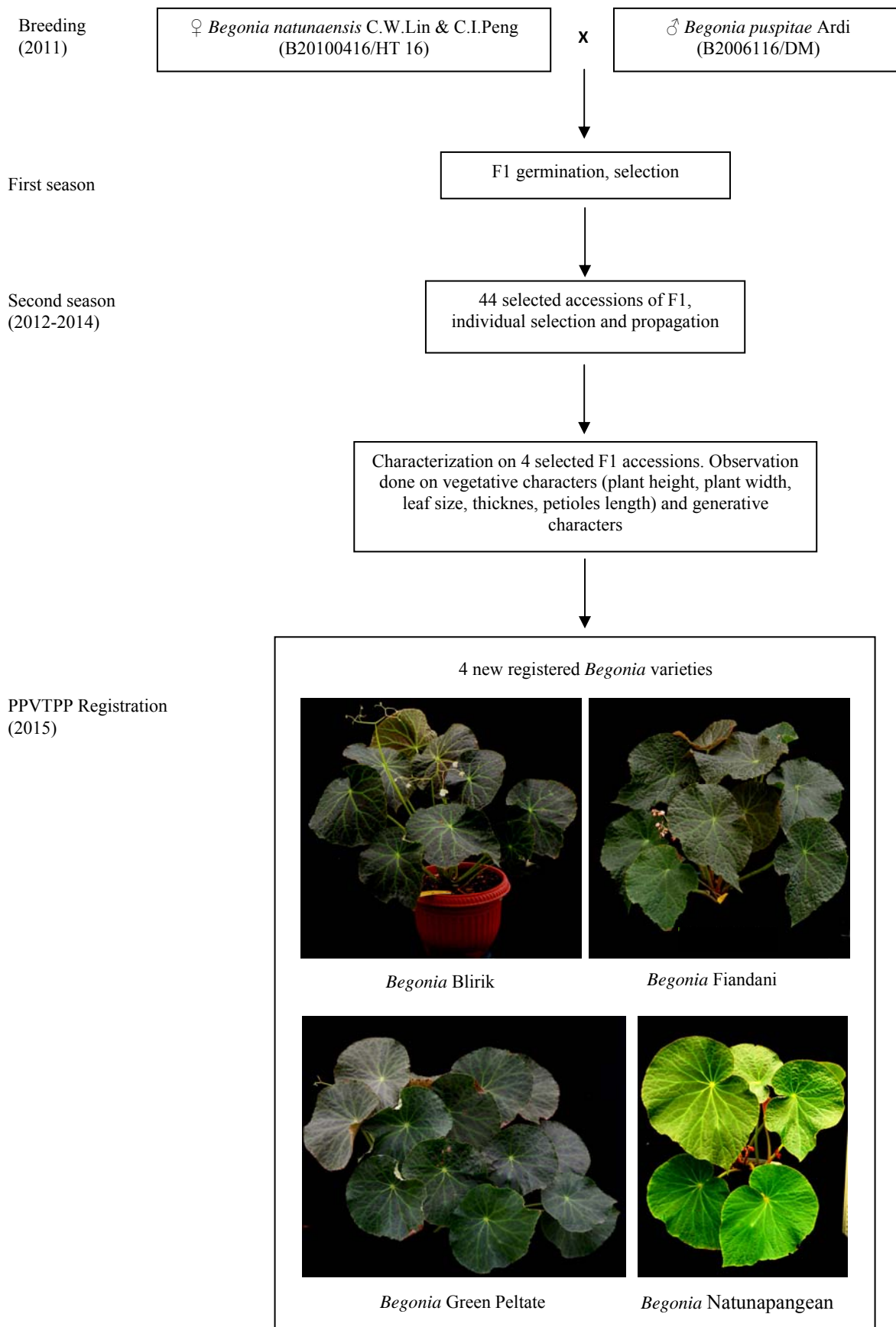
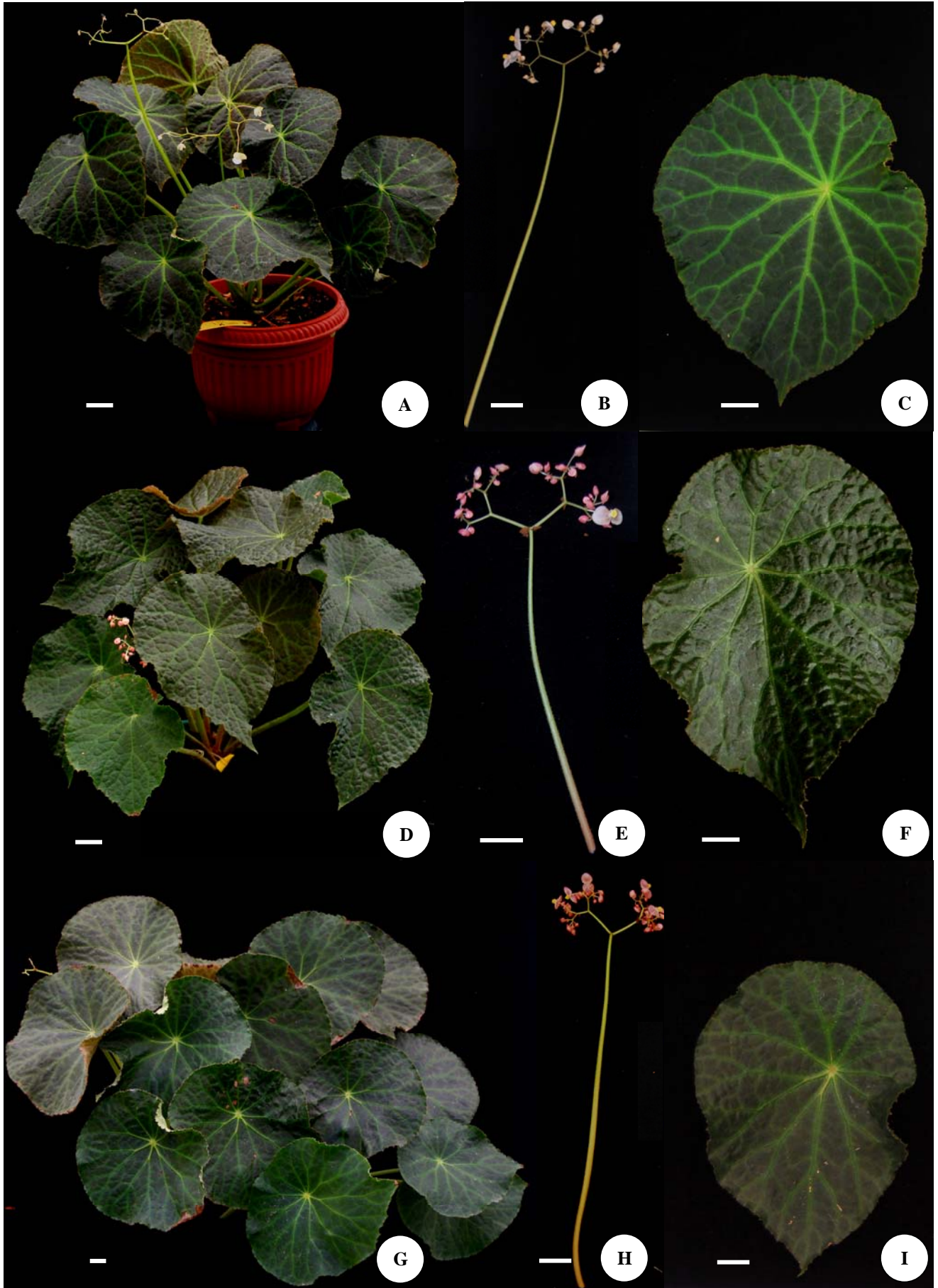


Figure 1. Four new *Begonia* hybrid varieties and the breeding scheme that produced them



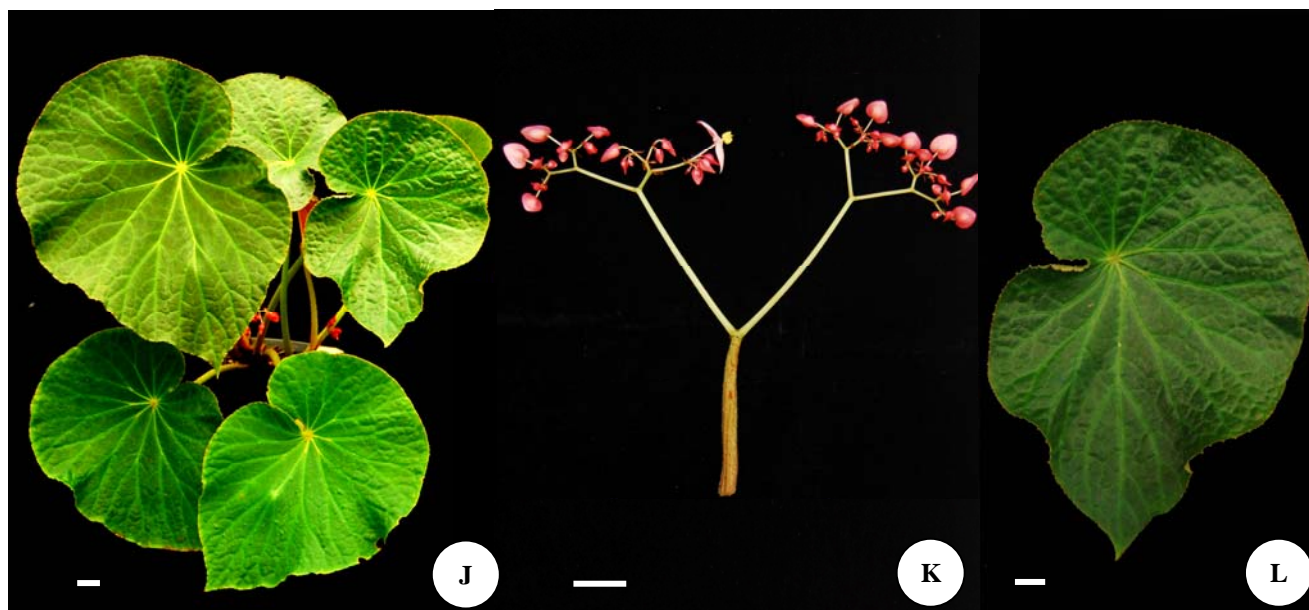


Figure 2.A-C. The morphological features of *B. Blirik* leaves and inflorescence. E-F. Morphological features of *B. Fiandani* leaves and inflorescence. G-I. Morphological features of *B. Green Peltate* leaves and inflorescence. J-L. Morphological features of *B. Natunapangean* leaves and inflorescence. Bar = 2 cm

Begonia Fiandani

Rhizome plant type, plant height (25.50 cm). Single leaf blade, peltate, leaf shape ovate, upper surface of leaf color green G 137 B, the color of the bottom surface of the leaves yellowish green YG 144 C. Single flower, pink color RP 69 A. Stature strong and sturdy plants suitable as beautiful leafy ornamental plants in pots. Different characteristics from the parent are the green leaf color, corrugated surface, pink flowers. First flowered in January 2012. The derivation of the name comes from the name of the breeder's wife. *B. Fiandani* is registered by letter as No. 348/PVHP/2015, characterized by dark green leaf color, corrugated surface, pink flowers (Figure 2.D-F).

Begonia Green Peltate

Rhizome plant type, plant height (31.5 cm). Single leaf blade, peltate, the base corrugated, leaf shape ovate, upper surface of the leaf color green G 137 A, glossy, leaf color green bottom surface red RP 65 C, single flower, red color RP 62 B. Different characteristics from the parent are peltate leaves, the base corrugated, large leaf size, leaf surface is curved, red flower. Plant stature strong and suitable as an ornamental beautiful leafy potted flowering plant. It flowered for the first time in January 2012. The derivation of the name is based on the unique peltate leaf form with dominant green colour. *Begonia Green Peltate* is registered by letter as No. 345/PVHP/2015 (Figure 2.G-I).

Begonia Natunapangean

Rhizome plant type, plant height (29.00 cm). Single leaf blade, position of petiolar attachment basifixed; leaf shape

ovate, the leaf base cordate, leaf color upper surface of the green G 137 C, the color of the leaf surface green, bottom reddish RP 65 C. Single flower, red color RP 62 C. Different characteristics from the parent are the ovate leaves, green color, position of petiolar attachment basifixed, the leaf base cordate, red flower. Plant first flowered January 2012. The plant stature is strong, fit as beautiful leafy ornamental plants in pots. Derivation of the name comes from the name of the location of the parents, coming from Natuna Island and Batang Pangean (West Sumatra). *B. Natunapangean* is registered by letter as No. 346/PVHP/2015 (Figure 2.J-L).

In conclusion, hybridization between different species *Begonia* produced new varieties that are more interesting, unique and better than their parents. The four new varieties are registered on PPVTPP as *B. Blirik*, *B. Fiandani*, *B. Green Peltate* and *B. Natunapangean*. These new varieties are ornamental leaf *Begonia* that have potential economic value.

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