

The New Domestic *Hydrangea macrophylla* Cultivar ‘Moonlight’

Seong-Hwa Bak^{1,2} , Hyo Jin Jung³, Ji min Lim^{1,2}, Jae Shin Lee⁴, and Tae-Ho Han^{1,2*} 

¹Department of Horticulture, Chonnam National University, Gwangju 61186, Korea

²Interdisciplinary Program in IT-Bio Convergence System, Chonnam National University, Gwangju 61186, Korea

³Department of Garden Industry, The Suncheon Bay management center, Suncheon 58000, Korea

⁴Jeonnam Agricultural Research & Extension Services, NaJu 58213, Korea

*Corresponding author: wageningen@hanmail.net

Abstract

The *Hydrangea* ‘Moonlight’ cultivar was registered in 2020 by Chonnam National University. In 2015, mophead-type *H. macrophylla* ‘Adria’ and mophead-type *H. macrophylla* ‘Ocean’ were crossed, and the progenies were grown in 2016. We screened and selected for disease resistance lines during a field trial in 2016, and investigated the flower type, floral color, and growth type from 2017–2018. Finally, we selected the distinctive line D15009. The showy sterile flower’s (sepal) color was pinkish (RHS Color Chart Purple Group 75C) and the floral head type was mophead. The inflorescence width and height were 7.80 and 14.84 cm, respectively. The average number of showy sterile flowers (calyxes) per inflorescence was 152.3, and they were scentless. The average plant height was 56.83 cm and the growth type was semi-erect with stems that were bowing. Leaf length and width were 11.22 and 7.20 cm, respectively. ‘Moonlight’ was a late flowering garden cultivar. Flowers began to bloom in mid-April in the greenhouse, but in early June in the outer fields. There was a wide variation in flower color, ranging from pink, dark purple, and blue in accordance with the measurement of soil pH during gardening and pot cultivation. A new *Hydrangea* cultivar, ‘Moonlight’ was registered with the Korea Seed and Variety Service (plant variety protection number: 8059).

Additional key words: cross breed, flowering time, mophead, ornamental plant, sepal color

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Introduction

The genus *Hydrangea* consists of approximately 23 species, several of which are cultivated as ornamentals (McClintock, 1957). These plants are distributed throughout East Asia, Eastern North America, and South America. The genus *Hydrangea* is one of the most popular ornamental flowers. *Hydrangea macrophylla* is the most popular and most cultivated species of the *Hydrangea* genus. Generally, hydrangeas refer to *H. macrophylla* and they may be either a mophead or lacecap type (Uemachi and Nishio, 2005; Uemachi et al., 2006; Kitamura and Ueno, 2015; Lee et al., 2019). *H. macrophylla* is a popularly cultivated horticultural crop grown in America, Asia, and Europe.

Because of its large and colorful showy inflorescences, this native of Asia is grown as both a garden shrub and as cut flowers (Kitamura and Ueno, 2015; Lee and Lee, 2018). This flower is valued for its large corymbs, which range from pink to blue in color and from pale to deep color in intensity, depending on the soil pH and cultivar genotypes. *H. macrophylla*, with over 1000 cultivars, is one of the most important flowering shrubs, and its popularity is attributed to its versatility as a garden shrub, a florists’ pot plant, and a cut flower. In Korea, *Hydrangea* is a summer flowering shrub with a long flowering period. However, foreign varieties dominate the Korean market, which warrants the development of domestic cultivars. Accordingly, we initiated a breeding program at Chonnam National University in 2014. We performed inner-species crosses to develop marketable domestic hydrangea for cut flowers and garden use, and inter-species crosses for greater crossing ability using close species in the same genomic section (Islam et al., 2020).

Materials and Methods

Plant Materials

In 2015, the mophead-type *H. macrophylla* ‘Adria’ with deep pink color and the mophead-type *H. macrophylla* ‘Ocean’ with light pink color were selected for crossing (Fig. 1). Capsules were collected in early winter and dried in small paper bags. The capsules were broken, and the seeds were collected. The seeds were surface-sown on rock wools in flats filled with enough water to retain moisture. The progenies were obtained in 2016. In this experiment, two contrasting cultivars, *H. macrophylla* ‘Moonlight’ and *H. macrophylla* ‘Verena’ were cultivated.

Investigation Methods

To investigate horticultural characteristics, plantlets were propagated by the cutting method from the mother plant, and grown in round plastic pots (15 × 20 cm) filled with horticultural soil No. 2 (Bio Best Soil, ©Heungnong) for the first year. During the second and third years, plants were cultivated in square plastic pots (34 × 34 × 28 cm) filled with horticultural soil No. 2 to increase the plant’s volume. Plants were regularly irrigated overhead according to the weather. Characteristics were investigated from the third year of cultivation. The characteristics of hydrangeas were investigated



Fig. 1. Flower characteristic of parents. (A) ‘Adria’ as the maternal plant (B) ‘Ocean’ as the paternal plant.

according to Korea Seed & Variety Service guidelines (KSVS, 2015).

The soil pH was measured in each pot showing a different flower color as described by Kim et al. (1999). The seedlings were propagated by the cutting method of the parent plant, and the rooted plants were cultivated for 2 years in round plastic pots (15 × 20 cm) filled with gardening soil No. 2. Eight soil samples from each pot were transferred to the laboratory and dried in the shade for 2 weeks. Later, they were filtered with a 2mm sieve and used for soil hydrogen exponent analysis (Kim et. al., 2007). Soil pH was measured with a pH meter (Orion Star A211, Thermo) by mixing the dried soil in distilled water (1:5), shaking for 30 min, and then filtering with filter paper (ADVATEC No. 6).

To standardize the development of *H. macrophylla* flower buds in South Korea, the growth of hydrangea flower buds outside the greenhouse was observed every month from October 2019 to February 2020. The largest flower buds were collected for the analysis on the day of the survey. The bracts were removed with sharp tweezers. The flower buds were cut with a scalpel and visualized using a stereoscopic microscope (KL200LED, Carl Zeiss). The floral development of *H. macrophylla* was divided into seven stages (Gilles et al., 2008).

Results and Discussion

Breeding Process

In June 2015, we crossed the mophead-type *H. macrophylla* ‘Adria’ (maternal plant) with the mophead-type *H. macrophylla* ‘Ocean’ (paternal plant), and obtained 122 capsules in the early winter. The capsule were sown in March 2016 and we obtained 10 breeding lines. We screened and selected for disease resistance lines in the field trial and investigated the flower type, floral color, and growth type in 2016 – 2017. Finally, we selected the breeding line D15009. In 2018, a new variety for plant protection (application number: 2018-35) was submitted. In 2020, a new *H. macrophylla* ‘Moonlight’ was registered (plant variety protection number: 8059) with the Korea Seed and Variety Service (Figs. 2 and Fig. 3).

Years	2014	2015	2016 – 2018	2018	2020
	Collected parental plants	‘Adria’ X ‘Ocean’	Sowing and seedling	Investigation of growth and flowering characteristics	Application for the registration of plant variety
					Plant variety registered

Fig. 2. Pedigree analysis of the new *Hydrangea macrophylla* cultivar ‘Moonlight’.

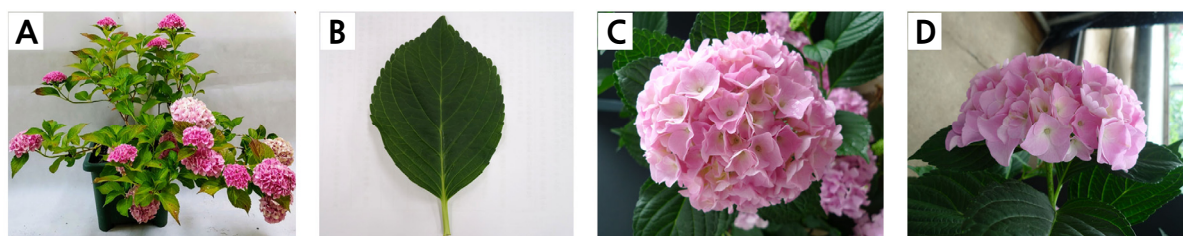


Fig. 3. The new *Hydrangea macrophylla* cultivar ‘Moonlight’. (A) Entire plant (B) Plant leaf (C) Top view of the flower (D) Side view of the flower.

Main Characteristics

The heights of ‘Moonlight’ and ‘Verena’ were 56.83 and 84.30 cm, respectively. ‘Moonlight’ was semi-erect, and ‘Verena’ was completely erect. The stems of ‘Moonlight’ grew in an artistically bowing fashion. The width and length of the leaves of the ‘Moonlight’ were 7.20 and 11.22 cm, respectively, and those of ‘Verena’ were 8.81 and 13.45 cm, respectively. ‘Moonlight’ had slightly smaller leaves than ‘Verena.’ The lengths of the leaf tips of ‘Moonlight’ and ‘Verena’ were 11.57 and 12.60 mm, respectively, and the leaves of ‘Verena’ were more pointed. ‘Moonlight’ was more suitable for gardening than for use as a cut flowers (Table 1). The floral head type was mophead. The sepal color of ‘Moonlight’ was light purple-pink (75C). ‘Moonlight’ was more pinkish than ‘Verena’, which belongs to the red-purple group (65D). Inflorescence height and width of ‘Moonlight’ were 7.08 and 14.84 cm, respectively, and those of ‘Verena’ were 8.77 and 16.97 cm, respectively, slightly larger than ‘Moonlight’. The sepals of ‘Moonlight’ and ‘Verena’ measured 3.35 and 3.98 cm in diameter, respectively, and ‘Verena’ was slightly larger than ‘Moonlight.’ Although the overall inflorescences and sepal size of ‘Moonlight’ was small, the numbers of infertile flowers per inflorescence of ‘Moonlight’ and ‘Verena’ were 152.30 and 133.30, respectively, and ‘Moonlight’ carried more infertile flowers than ‘Verena’ (Table 2).

Mophead and lacecap hydrangeas grown in a wide range of soil pH result in various floral colors. Accordingly, the flower color of ‘Moonlight’ varied depending on the soil pH. Eight samples were taken based on distinct flower colors. The color spectrum ranged from blue to pink (Fig. 4). The flower color was blue-purple in plants grown in soils that had a pH between 4.54 and 4.69. The flower color in soil pH 4.91 was purple-pink. In soils at pH 5.26, 5.34, and 5.43, the flower color was pink. Hydrangeas remained pink when the soil pH was about 6.0 or 6.2. *H. macrophylla* had a varying aluminum content depending on the soil pH (Lee et al., 2014). Low soil pH (acidic) facilitated plant uptake of more aluminum and generated a beautiful blue color (Betty, 2017). ‘Moonlight’ had blue, purple, and pink flower colors when the soil pH was between 4 and 6. As a result, growers can produce various flower colors by controlling soil pH and aluminum uptake content.

Table 1. Characteristics of the new *Hydrangea macrophylla* cultivar ‘Moonlight’

Cultivars	Growth habit	Plant height (cm) ^z	Leaf length (cm)	Leaf width (cm)	Leaf tip length (mm)	Flowering time ^y
Moonlight	semi-erect	56.83 ± 2.24	11.23 ± 0.49	7.20 ± 0.21	11.57 ± 1.29	L
Verena	erect	84.30 ± 2.73	13.45 ± 0.57	8.81 ± 0.29	12.60 ± 1.38	M

^zMean ± SE (*n* = 10)

^yE = Early, M = Middle, L = Late

Table 2. Flowering and floral characteristics of a new *Hydrangea macrophylla* cultivar ‘Moonlight’

Cultivars	Inflorescence		Diameter of sepal (cm)	Shape of sepal	No. of sepals /inflorescences	Sepal color (RHS) ^y	Flower head type
	Height (cm) ^z	Diameter (cm)					
Moonlight	7.80 ± 0.18	14.84 ± 0.85	3.35 ± 0.08	single	152.30 ± 8.24	75C (Purple Group)	Mophead
Verena	8.77 ± 0.25	16.97 ± 0.74	35.72 ± 00.12	single	133.30 ± 7.71	65D (Red-Purple Group)	Mophead

^zMean ± SE (*n* = 10)

^yRHS (The Royal Horticultural Society) color chart, 2015.

Generally, *H. macrophylla* produces flower buds shortly after blooming, which means they flower in the previous year's wood (Betty, 2017). In Korea, *H. macrophylla* usually bloom from May to June. In the outdoor condition, the early stage of flower bud development was observed from October, and the final stage, when flower formation was complete, happened in February (Lim et al., 2020). *Hydrangea* blooms faster when grown in a heated greenhouse than when grown in the field (Lim et al., 2020). Fig. 5 illustrates floral bud development and blooming. Fig. 5B and 5J represent the floral buds of 'Moonlight' and 'Verena' grown in the same environment on the same day. The flowers of 'Verena' bloom faster



Fig. 4. Flower color of 'Moonlight' according to soil pH. (A) Flower in soil with pH 4.54 (B) Flower in soil with pH 4.69 (C) Flower in soil with pH 4.91 (D) Flower in soil with pH 5.26 (E) Flower in soil with pH 5.34 (F) Flower in soil with pH 5.43.

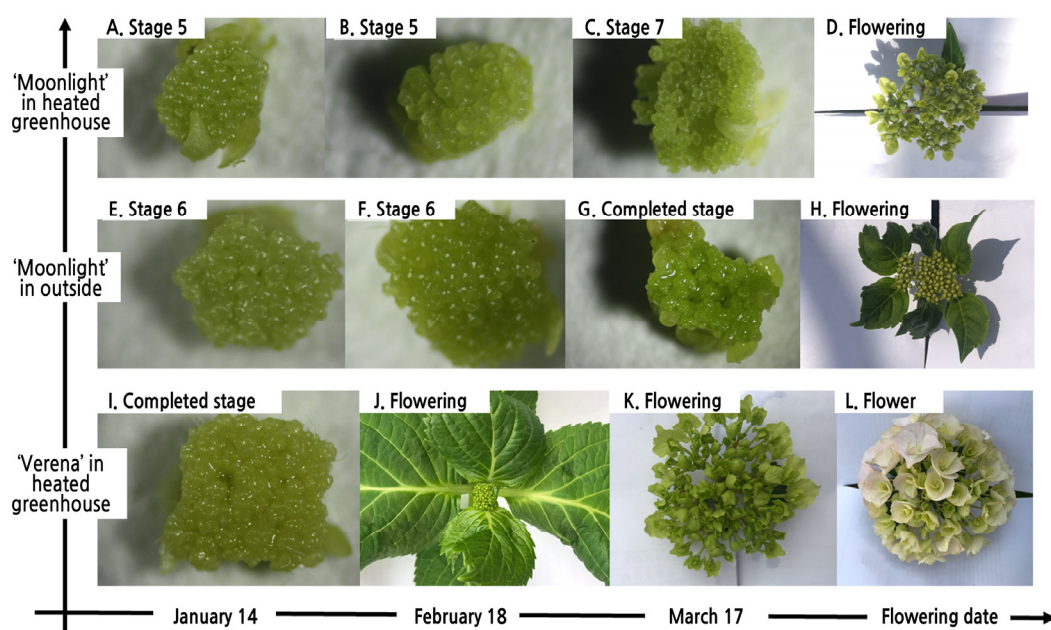


Fig. 5. Flower buds and first flowers of 'Moonlight' and 'Verena' appearing on different dates in 2020. (A) heated greenhouse on January 14th, (B) heated greenhouse on February 18th, (C) heated greenhouse on March 17th, (D) heated greenhouse on May 20th, (E) outside on January 14th, (F) outside on February 18th, (G) outside on March 17th, (H) outside on May 20th, (I) heated greenhouse on January 14th, (J) heated greenhouse on February 18th, (K) heated greenhouse on March 17th, and (L) heated greenhouse on April 4th. Flower buds development data from Lim et al. (2020).

than ‘Moonlight’. The flower of ‘Verena’ was observed on February 18th (Fig. 5J), while the flower of ‘Moonlight’ bloomed sometimes in April. In the same environment, the flowers at the same stage of development for ‘Moonlight’ were seen on May 20th (Fig. 5D) and those of ‘Verena’ on March 17th (Fig. 5K). These findings suggest that ‘Moonlight’ is a late-flowering cultivar that blooms about 2 months later than ‘Verena.’ In addition, the flowering date of ‘Moonlight’ growing in the heated greenhouse is about a month earlier than that of ‘Moonlight’ grown in the field (Fig. 5).

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