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A New Small Asian Pear: 'Solmi'

I.S. Shin, H.S. Hwang, S.S. Kang, Y.K. Kim, K.H. Cho, S.H. Kim,
D.H. Kim, and H.C. Lee

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Abstract

'Solmi' pear (*Pyrus pyrifolia* [Burm. F.] Nakai) was developed from a cross between 'Wonhwang' and 'Sunhwang' made in 1997 at the National Institute of Horticultural and Herbal Science of the Rural Development Administration in Korea. It was first selected as '97-10-80' in 2006 for its attractive eating quality and small size. After regional adaptability tests at 10 sites for 6 years from 2008 to 2013 as 'Wonkyo Na-58', it was named in 2013. It blooms one day later than 'Niitaka', a mid-late season leading pear cultivar and one day earlier than 'Wonhwang' in Korea. 'Solmi' is vigorous and has an upright-spreading tree habit. It is classified as moderately resistant to pear scab (*Venturia nashicola* Tanaka & Yamamoto) having a degree of susceptibility similar to 'Wonhwang'. 'Solmi' was cross-compatible with major Korean pear cultivars such as 'Niitaka', 'Wonhwang' and 'Chuhwangbae'. The average optimum harvest date of 'Solmi' was determined as Sept. 10, two days later than 'Wonhwang'. The fruit is oblate in shape and yellowish-brown in skin color. Average fruit weight in the trials was 391 g and total soluble solids concentration was 12.5°Brix.

In Korea, Asian pear is considered to be one of the most important fruit crops, ranked fifth behind apple, citrus, persimmon and grape. It is used as a sacrificial fruit for Jesa, a traditional Korean ceremony that honors one's ancestors. Approximately 60% of fruit are consumed around two national holiday seasons - Chuseok, Korean Thanksgiving Day (August 15 in the lunar calendar) and the Lunar New Year. In order to meet demand in these two seasons, the pear industry has been focused on producing fruits that are not for regular home consumption as a favorite and functional food with affordable medium or small-sizes, but for gifting as a present or for holding a memorial service for ancestors using large-sized fruit with good appearance and long storability. As a consequence, the growing area and pear production have each markedly diminished from 26,200 ha in 2000 and 467,426 MT in 2007, to 13,100 ha and 302,731 MT in 2014. Over the last 15 years, cultivation has favored the production of large-sized and good looking fruit such as 'Niitaka', a major cultivar accounting for 83% of planted area, and 'Wonhwang' (Kim et al., 1995), a leading cultivar for the early season which comprised 5.9% of production in 2014 (Statistics Korea, 2014). In Korea, the size grades for Asian pear are as follows: very small, < 300 g; small, 300~400 g; medium, 401~500 g; large, 501~600 g; and very large >601 g. According to the Statistics Korea Bureau, the proportion of the population living in one and two-person households is increasing, similar to that in the U.S. and many other countries. Only 15.3% of Korean households consisted of one or two persons in 1980 and this figure has grown steadily over the past three decades, reaching 48.2% by 2010. For the purpose of expanding Asian pear consumption, new small-sized cultivars with attractive fruit quality have been requested for home use.

Materials and Methods

A total of 637 seedlings from 770 seeds were obtained from a cross, made in 1997 at the National Institute of Horticultural and Herbal Science, Rural Development Administration in Korea, between 'Wonhwang' and 'Sunhwang' (Hwang et al., 2002), which has

National Institute of Horticultural & Herbal Science, RDA, Wanju, 563-852, Korea

medium harvest maturity and long shelf life. Of the 637 seedlings, 265 were planted in a breeding field located in Hwaseong (37.23N, 126.95E) in 2003. A seedling labelled as '97-10-80' was initially selected in 2006 for its good eating quality and small fruit size. After initial selection, eight trees each of '97-10-80' and the control cultivar 'Wonhwang', were propagated on *P. betulaefolia* seedling rootstock, and planted in the same row with a 2 m (in row) × 6 m (between row) spacing in 2008 at 10 geographic locations. All trees were trained to a central leader growth habit. After regional adaptability tests at the 10 sites, spanning the far northern (Chuncheonsi, 37.52N, 127.53E), far southern (Jinjusi, 35.11N, 128.09E), far western (Naju-si, 35.01N, 126.71E), and far eastern (Daegusi, 35.87N, 128.57E) regions in latitude and longitude, for 5 years from 2008 to 2013 as 'Wonkyo Na-58', it was selected and named in 2013. Trees were evaluated for flower, tree and fruit characteristics including fruit set ratio. The latter was determined by covering flower clusters with paper bags at the balloon stage to ensure self-pollination according to the manual for Agricultural Investigation (RDA, 2003, 2012) and related guidelines (UPOV, 1994). During the flowering period, 100 flowers at the balloon stage in the second or third position of a flower cluster were picked and anthers were collected. After dehiscence of anthers for 24 h at 20°C, pollen was collected using the 100% acetone dipping method (Niimi and Yu, 1992), and total quantity was weighed.

Cross compatibility with 'Solmi' was evaluated using over 100 flowers from each of five commercial cultivars. Two flowers per flower cluster at the balloon stage were retained and each flower was emasculated by hand and covered with a paper bag until pollination. Pollination was tested with 'Niitaka', 'Wonhwang', 'Hwasan', and 'Hwangkeumbae'. Fruit set was determined 30 days after the full bloom stage.

Each spring, flower and fruit thinning were carried out to prevent biennial fruiting. Final distance between fruits at harvest was maintained at a minimum of 20 - 30 cm. Yield was estimated compared to parameters of 'Wonhwang', such as fruit weight and number of fruit set per branch.

As trees came into bearing, five fruit were taken from each of eight trees at two-three times to ascertain the time of optimum maturity. After the fruits were weighed, they were cut in half longitudinally. Flesh firmness was measured on each side of the fruit with a hand-held penetrometer (QAsupplies FT327, USA) equipped with an 8 mm diam. plunger. Thereafter, total soluble solids concentration was measured on each fruit by expressing juice from each side of the fruit onto a digital refractometer (Atago PR-101, Japan). Titratable acidity of each fruit was measured from 10 mL samples of squeezed juice plus 40 mL distilled water and reported as percentage in terms of malic acid equivalents. The solution was titrated to an endpoint of pH 8.1 using 0.1N NaOH. Titrations were performed using an auto-titrator (Schott TitroLine Alpha, Mainz Germany). Sensory evaluation for grit (stone cells), flesh juiciness, appearance and overall taste was conducted by three trained panelists. Storability of 'Solmi' and 'Wonhwang' at 2°C was investigated by measuring losses of fruit weight and fruit firmness every 20 days until 120 days after storage in 2013. Each sampling comprised three replications with three fruits per replication. Fruit weight loss and fruit firmness loss were calculated as the difference between values at harvest time and those determined every 20 days. Fruit that had decreased by more than 10% of the harvest time values were considered unacceptable.

Degree of scab caused by *V. nashicola* was estimated according to the methods of Abe and Kurihara (1992), Langford and Keitt (1942) and Shin et al. (2004, 2007).

Statistical significance was calculated by Tukey's studentized range (HSD) test of GLM using SAS statistical software (V 9.1, SAS Institute Inc., North Carolina, USA).

Table 1. Tree characteristics and disease resistance to scab of 'Solmi' pear at Suwon, Korea, from 2011 to 2013.

Cultivar	Full bloom date	Tree habit	Tree vigor	No. of spurs	Pollen quantity (mg/100 flowers)	Scab resistance[z]
Solmi	Apr. 28ns[y]	Upright spread	Strong	Moderate	Abundant (130)ns	S
Wonhwang	Apr. 29	Upright spread	Strong	Moderate	Abundant (125)	S

[z] HR (highly resistant), no visible symptoms on all leaves; R (resistant), yellow or necrotic lesions with no sporulation on a few leaves; S (susceptible), sparsely sporulating lesions on a few leaves or petioles; HS (highly susceptible), abundant sporulating lesions on several leaves or petioles.

[y] ns, non-significant at P≤0.05, according to t-test, compared with control.

Description

'Solmi' has strong tree vigor and an upright-spreading tree habit (Table 1). It bloomed one day earlier than 'Wonhwang', a leading and its maternal cultivar for early maturing and one day later than 'Niitaka', a major cultivar without pollen for mid-late season production in Korea. Spurs and the number of axillary flower buds on 1-year-old shoots were moderate. Precocity was similar to 'Wonhwang' on *P. betulaefolia* rootstock, with the onset of fruiting occurring in the third year. Its full bloom date at Suwon was April 28, more than one day later than 'Niitaka' and 'Chuhwangbae' (Kim et al., 1986) and one day earlier than 'Wonhwang' and 'Hwasan' (Kim et al., 1994) over three years (2011 to 2013). It had 21 stamens per flower (a moderate number), less than the 23 stamens of 'Wonhwang' and 1.3 mg pollen per flower, similar to 'Wonhwang'. In pollination compatibility tests, 'Solmi' was moderate-highly compatible with all test cultivars, such as 'Niitaka', 'Wonwhang', 'Chuhwangbae' and 'Whankeumbae' (Kim et al., 1985) (Table 2). Accordingly, it is recommended for use, not just as a main cultivar but also as a pollinizer, in commercial orchards. 'Solmi' showed slight susceptibility to scab disease caused by *Venturia nashicola*, similar to 'Wonhwang' and more resistant than 'Niitaka' (Table 1). 'Solmi' was classified as resistant to black spot (induced by *Alternaria kikuchiana*) and as being in the symptomless group against apple stem grooving virus (data not shown). It should be noted that susceptibility to fireblight (*Erwinia amylovora*) was not evaluated as this is not a serious disease in Korea.

Optimum fruit harvest date at Suwon was Sept. 10, more than two days later than 'Wonhwang' and four weeks earlier than 'Niitaka' over the 2011-2013 period (Table 3). The fruit is oblate in shape and yellowish brown in skin color (Fig. 1). Average fruit weight, transverse and longitudinal diameter were 391 g, 82.9 mm and 73.6 mm, respectively. Its total soluble solids concentration averaged 12.5 °Brix and titratable acidity was 0.063%. Fruit flesh firmness, juice content and stone cell presence were similar to

Table 2. Cross compatibility of 'Solmi' pear at Suwon, Korea, 2013.

Cross combination	Fruit set (%)	Cross combination	Fruit set (%)
Niitaka × Solmi	40.0	Chuhwangbae × Solmi	50.0
Wonhwang × Solmi	71.7	Hwangkeumbae × Solmi	92.2
Hwasan × Solmi	50.0		

Table 3. Fruit characteristics and ripening time of 'Solmi' at Suwon, Korea from 2011 to 2013.

Cultivar	Maturity[z]	Fruit wt (g)	SSC[y] (°Brix)	Flesh firmness[x] (kgf)	Flesh (firmness/ texture)	Titratable acidity (%)	Storability (days at 2°C)	Yield (MT·ha^{-1})
Solmi	135ns[w]	391*	12.5ns	2.82ns	Soft/medium	Little (0.063)*	100*	31*
Wonhwang	132	587	12.2	2.64	Soft/fine	Little (0.125)	80	32

[z] Days after full bloom.
[y] Soluble solids concentration.
[x] Flesh firmness was evaluated with a 8 mm diam. plunger.
[w] NS, non-significant or *significant at P≤0.05, according to t-test, compared with control.

those of 'Wonhwang' being 2.82 kgf, 86.5% and negligible grit, respectively.

The fruit did not store for more than two weeks at ambient temperature or for more than 3 months after harvest at cold temperatures of approximately 1-2°C.

Availability

Protection for 'Solmi' was applied for in Dec. 2013 for registration in 2015 after two years of records on distinctness, uniformity and stability by Korean Seed Industry Law. Propagation material of 'Solmi' will be available after variety registration.

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Fig. 1: Fruit (left) and flowers (right) of 'Solmi'.

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