Breeding of a New Late-Maturing Pear Cultivar 'Suyu'

Lijuan GAO, Longfei LI, Jintao XU, Minghui JI, Huan LIU, Baofeng HAO*

Changli Institute of Pomology, Hebei Academy of Agricultural and Forestry, Changli 066600, China

Abstract The new late-maturing pear cultivar 'Suyu' was bred through hybrid breeding using 'Mili' as the female parent and 'Dangshansuli' as the male parent. This cultivar has a nearly round fruit shape with a greenish-yellow skin, an average single fruit weight of 394.3 g, and a small core. The flesh is white, fine-textured, crisp, juicy, sweet, and aromatic, with a soluble solid content of 12.8%. The tree has a strong growth vigor, an open canopy, high budding rate, and strong branching ability, making it suitable for spindle or cylindrical cultivation. The main color of the one-year-old branches on the sunny side is brown. The young leaves are yellowish-green, and the mature leaves are ovate with sharp serrations. Each inflorescence has 5 to 7 flowers with pink petals, a pistil that protrudes above the stamens, and purple-red anthers. The fruit development period is about 150 d, and it matures in mid-to-late September in Changli, Hebei. The cultivar is high-yielding, stable, and well-suited for storage. 'Suyu' can be cultivated in pear-growing areas of Hebei Province and regions with similar ecological types.

Key words Pear, New cultivar, 'Suyu', Late-maturing

0 Introduction

Pear is one of the world's major fruits, with 88 countries and regions producing pears[1]. China's pear cultivation area and production account for over 60% of the global pear area and output[2]. Hebei Province ranks among the top in the country in terms of pear cultivation area, production, and export volume, playing a significant role in China's pear industry[3-5].

Traditionally, 'Yali' and 'Xuehuali' have been the main pear cultivars in Hebei Province. In recent years, the pear cultivar structure in Hebei has been adjusted, with early, mid, and late-maturing varieties all having certain cultivation areas and yields[6-9]. To meet the diversified market demands, the variety structure has gradually shifted from a single type to a more diverse one, promoting the stable development of the pear fruit industry[10-13].

Since 2003, after 17 years of unremitting efforts, Changli Institute of Changli Institute of Pomology of Hebei Academy of Agricultural and Forestry Sciences successfully bred a new pear cultivar named 'Suyu' (Fig. 1) using the excellent germplasm resources of 'Mili' as the female parent and 'Dangshansuli' as the male parent through hybrid breeding technology. This new cultivar integrates high quality, high yield, storability, and late maturity.

1 Breeding process

In early April 2003, pollen from 'Dangshansuli' was collected at Anhui Agricultural University. In late April, artificial cross-pollination was conducted using 'Mili' as the female parent in Changli, Hebei. In September, the mature pollinated fruits were harvested, and the hybrid seeds were collected. In March 2004, the stratified seeds were sown in a greenhouse, and the hybrid seedlings were transplanted to the Dongshahe Base of Changli Institute of Pomology in late May. In 2008, the hybrid population was initially evaluated, and the selection '04-11-120' was chosen as the preliminary superior line due to its attractive appearance, delicious taste, and high yield. In 2009, it was grafted into the re-selection nursery for further evaluation. In 2012, regional adaptability trials were conducted in Changli, Luannan, and Botou, Hebei. After years of observation and testing, '04-11-120' demonstrated stable biological characteristics, fruit traits, and adaptability, with excellent overall quality. It met the requirements for a superior new cultivar and was approved by the Hebei Provincial Forest Variety Approval Committee in 2020, named 'Suyu' (variety number: Ji S-SV-PB-002-2020).

Fig. 1 A new late-mature pear cultivar 'Suyu'

2 Main characteristics

2.1 Botanical characteristics According to the *Descriptors and Data Standard for Pear*[14] and the pear DUS test guidelines[15], the new cultivar 'Suyu' exhibits strong tree vigor and an

Received: January 1, 2025 Accepted: February 10, 2025

Supported by Hebei Provincial Key Research and Development Program (21326308D-1-2); Hebei Provincial High-Level Talent Support Program (C20231157); Basic Research Funds of Hebei Academy of Agriculture and Forestry Sciences (2024020202).

Lijuan GAO, researcher, research fields: breeding of new pear varieties and research on cultivation techniques.

* Corresponding author. Baofeng HAO, researcher, research fields: breeding of new pear varieties and research on cultivation techniques.

open canopy. The one-year-old branches are erect, with an average internode length of 4.811 cm. The branches on the sunny side are mainly brown, and the dormant leaf buds are blunt and closely attached to the branches (Table 1). The young leaves are yellowish-green, and the mature leaves are ovate with sharp serrations. The leaf length is 9.629 cm, and the width is 7.098 cm. The leaf tip gradually tapers, the base is truncate, and the petiole length is 4.441 cm. There are no stipules at the base of the petiole. Each inflorescence usually contains 5 to 7 flowers, with an average corolla diameter of 3.691 cm. The petals are pink, overlapping, with a pistil that protrudes above the stamens, abundant pollen, and purple-red anthers.

Table 1 Comparison of main botanical characteristics between 'Suyu', its parents, and 'Yali'

Character	Suyu	Yali	Mili	Dangshansuli
Position of vegetative bud in relation to shoot	Adpressed	Markedly held out	Markedly held out	Markedly held out
Character of apex of vegetative	Obtuse	Obtuse	Obtuse	Acuate
Leaf shape	Ovate	Ovate	Ovate	Elliptic
Shape of leaf base	Truncate	Truncate	Truncate	Truncate
Shape of leaf apex	Gradually acuate	Gradually acuate	Sharp-acuate	Gradually acuate
Leaf margin	Serrate	Serrate	Serrate	Serrate
Lobe	Absent	Absent	Absent	Absent
Latitude of leaf in relation of shoot	Upwards	Downwards	Upwards	Upwards
Status of leaf surface	Flat	Wavy	Flat	Flat

2.2 Biological characteristics In the Changli area of Hebei Province, 'Suyu' begins flower bud break in late March, leaf bud break in early April, initial flowering in mid-April, and full bloom in late April, with a flowering period of 10 to 12 d. New shoots start vigorous growth in early May, and the fruits mature in mid-to-late September. The leaves fall in mid-November. The fruit development period is 150 to 160 d, and the nutritional growth period is approximately 240 d. The fruit is late-maturing and well-suited for storage.

2.3 Fruit economic characteristics The fruit of 'Suyu' is nearly round, with a greenish-yellow skin. The average single fruit weight is 394.3 g, the average fruit length is 8.843 cm, and the average diameter is 9.132 cm. The pedicel length is 3.296 cm, and the pedicel thickness is 0.294 cm. The pedicel cavity is deep, the sepals are deciduous, the eye basin is deep, and the core is small and spindle-shaped. The flesh is white, fine-textured, crisp, juicy, sweet, and aromatic, with a soluble solid content (w) of 12.8%. The fresh fruit quality is superior (Table 2). Compared with the control variety 'Yali', 'Suyu' has a more regular fruit shape, smaller core, higher edible rate, crisp and sweet flesh, and a richer flavor.

2.4 Growth and fruiting habits The young trees of 'Suyu' grow vigorously, and the growth rate slows down when they enter the full fruiting period, with no alternation of big and small years. Fine-budding rate and strong ability to form branches, with fruiting mainly occurring on medium and short fruiting branches. Flower buds are easily formed, and the fruit set rate is high. The fruit-bearing branches have a strong capacity for continuous fruiting, and the lateral shoots of the fruiting branches are vigorous. The high yields from the sixth year onwards. For trees over seven years old, the average yield per plant is controlled at 20 – 50 kg (depending on planting density), with an average yield of 3 500 – 4 500 kg/ha (Table 3).

Table 2 Comparison of main economic characteristic of 'Suyu' and 'Yali'

Trait	Suyu	Yali
Average weight per fruit//g	394.3	252.3
Fruit diameter//cm	9.132	7.730
Fruit length//cm	8.843	8.921
Fruit shape	Extremely globose	Obovate
Ground color	Green yellow	Green yellow
Amount of russeting	Few	Medium
Persistency of sepals	Deciduous	Deciduous
Depth of eye basin	Deep	Deep
Fruit core size	Small	Medium
Flesh firmness//kg/cm^2	8.08	6.22
Flesh color	White	White
Flesh texture	Fine	Fine
Flesh texture type	Crisp	Crisp
Amount of stone cells	Light	Light
Flavor	Sweet	Sour-sweet
Aroma	Aromatic	Weakly aromatic
Soluble solids content//%	12.8	10.9

Table 3 Comparison of yields between 'Suyu' and 'Yali' (kg/666.7 m^2)

Cultivar	The 6th year of transplanting	The 8th year of transplanting	The 7th year of transplanting
Suyu	51 857	55 619	55 902
Yali	43 751	42 921	43 242

2.5 Adaptability and resistance Since 2012, the cultivation of 'Suyu' in pear-growing areas such as Changli, Luannan, and Botou in Hebei Province has demonstrated characteristics such as early fruiting, high yield, excellent quality, and strong disease resistance. There has been no pre-harvest fruit drop, and the variety has a broad range of adaptability.

3 Key points of cultivation techniques

3.1 Orchard establishment and planting When establishing an orchard, it is advisable to select deep-soil flatlands or terraced

fields on hillsides. The soil should have a high organic matter content, and the site should have irrigation and drainage facilities, as well as convenient transportation. The recommended planting density is (1 – 3) m × (3.0 – 4.5) m. Pollinizer trees should be configured at a ratio of (4 – 5) ∶ 1, with suitable varieties including 'Xuehuali', 'Huangguan', and 'Xueqing'.

3.2 Shaping and pruning The spindle or cylindrical tree shapes are suitable for 'Suyu'. During the vigorous growth period of young trees, notching can be performed to promote branching of the central leader. Once lateral branches have developed, toothpicks can be used to open and spread the angles of the branches. Pruning should primarily focus on thinning out excessive branches, with more emphasis on releasing growth and less on heading back or shortening. Tree height should be controlled at around 3.0 – 3.5 m. During the full fruiting stage, attention should be paid to balancing the vigor of the upper and lower parts of the tree, and timely renewal and rejuvenation of fruiting branches should be conducted to maintain a stable tree structure.

3.3 Flower and fruit management 'Suyu' flowers easily and has a high fruit set rate after pollination. During the full fruiting stage, thinning of flowers and fruits is necessary. Thinning of flower clusters should be conducted from the flower cluster separation stage to before blooming, retaining those on strong fruit branches and removing those on weak ones. Bee hives can be placed in the orchard during the flowering period to increase the fruit set rate. In case of extreme weather during flowering, artificial pollination measures such as liquid pollination can be adopted. Thinning of fruits should begin 15 days after petal fall, primarily removing deformed, small, or bruised and scratched young fruits. One well-shaped, smooth, and undamaged fruit should be left every 15 – 20 cm. The leaf-to-fruit ratio should be maintained at 20 ∶ 1 to 25 ∶ 1, and single-tree yield should be controlled to prevent alternate bearing.

3.4 Fertilization and irrigation management Irrigation should be determined based on soil moisture conditions during the growing season, with either flood irrigation or drip irrigation being suitable. Freezing water should be applied before winter. The base fertilizer should be applied once in mid-October each year, primarily consisting of well-rotted organic fertilizers such as sheep manure or cow manure, at a rate of 45 – 75 m < sup > 3 < /sup > per hectare. The fertilization method should be adjusted according to cultivation conditions and combined with deep plowing after application. During the growth and development period, the soil should be fertilized in stages, with nitrogen fertilizer being the main focus in the early stage and compound fertilizers containing calcium, phosphorus, potassium, and magnesium being the main focus in the middle and late stages. This will increase tree nutrition, promote flower bud differentiation, and improve fruit quality.

3.5 Pest and disease control The main focus of pest control for 'Suyu' is to prevent pear psylla, pear fruit moth, and yellow aphids, with few disease occurrences. Before pear trees bud, a spray of 3 – 5° Bé lime-sulfur solution should be applied. Before fruit bagging, a mixture of 10% imidacloprid at 2 000 times dilution, 40% carbendazim at 1 000 times dilution, and 10% lambda-cyhalothrin at 1 000 times dilution should be sprayed. Combining conventional chemical control with physical and biological control methods will achieve better results.

4 Comprehensive evaluation and application prospects

'Suyu' is a new late-maturing, high-quality pear cultivar with regular fruit shape, high uniformity, crisp and juicy flesh, a fragrant aroma, and good storability. It demonstrates strong adaptability, high yield, and excellent fruit quality when cultivated in Hebei Province. It is suitable for cultivation in regions with similar ecological conditions.

References

[1] ZHANG SL. Pear[M]. Beijing: China Agriculture Press, 2013. (in Chinese).

[2] ZHANG SL, XIE ZH. Current status, trends, main problems and the suggestions on development of pear industry in China[J]. Journal of Fruit Science, 2019, 36(8): 1067 – 1072. (in Chinese).

[3] WEI HY, WANG GY, ZHANG YX. Big data construction of pear industry in Hebei Province[J]. Journal of Fruit Science, 2018, 35(S): 43 – 45. (in Chinese).

[4] WU T, YUAN TT, SHANG CM, *et al.* An Analysis of China's pear export structure[J]. Journal of Hebei Agricultural University (Social Sciences), 2019, 21(2): 7 – 10. (in Chinese).

[5] WANG WH, JIA XH, DU YM, *et al.* Current situation, problems and development trend of production and storage of pear in China[J]. Storage and Process, 2013, 13(5): 1 – 8. (in Chinese).

[6] WANG YB, LI X, WANG J, *et al.* A new early ripening pear cultivar 'Jixiu'[J]. Acta Horticulturae Sinica, 2020, 47(S2): 2883 – 2884. (in Chinese).

[7] ZHAO JX, GUO WZ, QIN SJ, *et al.* Breeding report of a new pear cultivar 'Qiuguang'[J]. Journal of Fruit Science, 2020, 37(6): 939 – 941. (in Chinese).

[8] LI LF, ZHAO SJ, GAO LJ, *et al.* Breeding report of a new disease-resistant, middle ripening pear cultivar Shuoyu[J]. Journal of Fruit Science, 2018, 38(5): 831 – 834. (in Chinese).

[9] LI HX, WANG W, ZHAO MX, *et al.* Ganli 2, a new early variety with high quality[J]. Journal of Fruit Science, 2021, 38(9): 1611 – 1614. (in Chinese).

[10] SHI HJ, WANG JQ. Present situation and countermeasure analysis of pear industry in Hebei Province based on SWOT method[J]. China Fruit, 2019 (1): 96 – 99.

[11] ZHANG HE, YUE WQ, RAN XT, *et al.* Application status, problems and solutions of pear varieties in Hebei Province[J]. Journal of Hebei Agricultural Sciences, 2010, 14(10): 24 – 25, 30. (in Chinese).

[12] GAO LJ, ZHANG HE, XU JT, *et al.* Present situation, existing problems and development countermeasures of pear industry in Hebei Province[J]. South China Fruits, 2018, 47(S1): 119 – 121. (in Chinese).

[13] LIU HL, TIAN LQ, WANG SS, *et al.* Present situation and development countermeasures of pear industry in Hebei Province[J]. China Fruit, 2013(3): 82 – 84. (in Chinese).

[14] CAO YF, LIU FZ, HU HJ, *et al.* Descriptors and data standard for pear (*Pyrus* spp.)[M]. Beijing: China Agriculture Press, 2006. (in Chinese).

[15] WANG F, FANG CQ, WANG FH, *et al.* Guidelines for the conduct of tests for distinctness, uniformity and stability-Pear (*Pyrus* spp.): GB/T 19557.30-2018[S]. Beijing: China Standard Press, 2018. (in Chinese).