Effect of Different Pollination Varieties on Qingxiang Pear Fruit Quality

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Abstract With Qingxiang pear as test material, we study the effect of different pollination varieties on Qingxiang pear fruit quality. The results show that Xinshiji, Xizilu, Cuiguan and Yuanhuang as the pollination varieties for Qingxiang pear can create the best comprehensive quality, and these varieties can be chosen in production as the pollination varieties for Qingxiang pear, followed by Cuilu and Xishui.

Key words Qingxiang pear, Pollination, Fruit quality

1 Introduction

Qingxiang is a variety bred from Xinshiji × Sanhuali by Institute of Horticulture of Zhejiang Academy of Agricultural Sciences in cooperation with Hangzhou Institute of Pomology. It is now the new medium maturing pear variety with the largest fruit shape in China. Qingxiang pear is a typical gametophytic self-incompatibility fruit, and in the production practice, pollination trees must be properly configured to complete pollination and fertilization. During the production process, bad weather and other factors often affect the spread of pollen and pollen germination[1]. Therefore, it needs appropriate pollination varieties and pollination methods to solve the problem in the production, and artificial pollination can overcome the above natural constraints. In this paper, we study the effect of different pollination varieties on setting percentage and fruit quality of Qingxiang pear, in order to select the pollination varieties that can promote setting percentage of Qingxiang pear and improve fruit quality, and provide a reference for the actual production in the future.

2 Materials and methods

2.1 Materials The test material is taken from pear orchard in Changlandifan demonstration zone of Yuyao Ditang Street in Zhejiang Province, with good irrigation and drainage conditions and high management level. The Qingxiang pear tree for test is eight years old, and the spacing in the rows and between rows is 2 m × 4 m. Pergola is used for cultivation and the way the tree is growing is at middle level. The pollination variety Xuehua is purchased from Dalian Delihong Pollen Research Institute. For the 9 pear varieties (Cuilu, Cuiguan, Jincunqiu, Xizilu, Yuanhuang, Huanghua, E'li 2, Xinshiji, Xishui), the flowers are collected 1 -2 d before flowering, and the collected anthers are isolated and baked. The pollen is separately taken.

2.2 Methods When the flowering rate of Qingxiang mother tree reaches 30%, the rubber tip is used for artificial pollination after 9:00 in a sunny windless day. 20 inflorescences per plant are selected, and 2 - 3 ray flowers are selected from each inflorescence. Each pollination variety is given to 5 plants, with natural pollination (CK) as control. It is bagged after removal of the central flower, and the bag is removed after fruit setting (10 d after pollination). The fruit-setting rate is investigated after the first physiological fruit drop. During harvesting, 10 fruits are randomly collected from each tree under each treatment, and the appearance quality (such as skin color and cleanliness) is observed and appraised. We also determine and compare the inherent quality (such as single fruit weight, hardness, soluble solids, soluble sugar content, titratable acid content, Vc content).

2.3 Quality measurement Single fruit weight is determined using electronic scale; fruit vertical and horizontal diameter, fruit core size and flesh transverse diameter are measured with vernier caliper; peeled fruit hardness is determined using GY-1 fruit hardness tester; soluble solids are determined using WYT-4 handheld refractometer; soluble sugar is determined using modified DNS method[2]; titratable acid is determined using alkaline titration method[3]; reduced vitamin C (Vc) is determined using molybdenum blue colorimetric method[4].

2.4 Data processing All data are processed with Excel, and Duncan test is conducted using SPSS software. In the significance test, containing the same letter indicates non-significant difference, while containing different letters indicates significant difference.

3 Results and analysis

3.1 Effect of different pollination varieties on Qingxiang pear fruit-setting rate As can be seen from Table 1, different pollination varieties have different effects on Qingxiang pear inflorescence and flower fruit-setting rate, and after pollination, Qingxiang pear inflorescence fruit-setting rate reaches more than

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80%, and the inflorescence fruit-setting rate of Yuanhuang, Cuiguan, Xuehua, Cuilu, Xizilu and Jincunqiu is more than 90%; the flower fruit-setting rate is also more than 80%, 16% higher than that under the control. Only 5% of flowers to bear fruit can meet the actual production needs[5], so the above varieties can be regarded as pollination varieties of Qingxiang pear in terms of inflorescence fruit-setting rate and flower fruit-setting rate.

Table 1 Effect of different pollination varieties on Qingxiang pear fruit-setting rate

Pollination varieties	Number of pollinated inflorescences	Inflorescence fruit-bearing number	Inflorescence fruit-setting rate//%	Number of pollinated flowers	Flower fruit-bearing number	Flower fruit-setting rate//%
Yuanhuang	100	92	92	272	231	84.93
Cuiguan	100	90	90	286	245	85.66
E'li 2	100	88	88	300	246	82.00
Xuehua	100	91	91	245	211	86.12
Xinshiji	100	87	87	284	241	84.86
Cuilu	100	91	91	277	234	84.48
Xizilu	100	92	92	296	252	85.14
Huanghua	100	85	85	284	232	81.69
Xishui	100	84	84	296	241	81.42
Jincunqiu	100	92	92	264	221	83.71
CK	100	82	82	258	168	65.12

3.2 Effect of different pollination varieties on Qingxiang pear appearance quality The effect of different pollination varieties on Qingxiang pear appearance quality can be shown in Table 2. In terms of skin color, Xinshiji and Xishui are bluish yellow, and other varieties are pale green and yellow. After pollination, Xizilu and Huanghua have few brown spots on fruit surface, small and sparse fruit dots; Xinshiji has small and dense fruit dots; Yuanhuang, Xuehua, Cuilu, Jincunqiu and control have large and sparse fruit dots; Cuiguan, E'li 2 and Xishui have large and dense fruit dots. In terms of taste, Huanghua is not light and crisp; E'li 2, Xishui and control are coarse and crunchy; other varieties after pollination are fine and crisp. In terms of flavor, Huanghua and control are mild; Xuehua and Cuilu are moderately sweet; other varieties are sweet. In terms of stone cell content, it is low for E'li 2, Cuilu, Huanghua, Xishui and Xishui; it is extremely low for other varieties. With Yuanhuang, Cuiguan, Xinshiji, Xizilu and Xishui as pollination varieties of Qingxiang pear, the Qingxiang pear appearance quality is best.

Table 2 Effect of different pollination varieties on Qingxiang pear appearance quality

Pollination varieties	Skin color	Skin cleanliness	Fruit dot size	Taste	Flavor	Stone cell content
Yuanhuang	Yellow	Few brown spots	Large and sparse	Fine and crisp	Sweet	Extremely low
Cuiguan	Yellow	Few brown spots	Large and dense	Fine and crisp	Sweet, fragrant	Extremely low
E'li 2	Pale green	Few brown spots	Large and dense	Coarse and crunchy	Sweet	Low
Xuehua	Pale green	Few brown spots	Large and sparse	Fine and crisp	Moderately sweet	Extremely low
Xinshiji	Bluish yellow	Few brown spots	Small and dense	Fine and crisp	Sweet	Extremely low
Cuilu	Yellow	Few brown spots	Large and sparse	Fine and crisp	Moderately sweet	Low
Xizilu	Pale green	Few brown spots	Small and sparse	Fine and crisp	Sweet, fragrant	Extremely low
Huanghua	Pale green	Few brown spots	Small and sparse	Not light and crisp	Mild	Low
Xishui	Bluish yellow	Few brown spots	Large and dense	Coarse and crunchy	Sweet	Low
Jincunqiu	Yellow	Few brown spots	Large and sparse	Fine and crisp	Sweet	Extremely low
CK	Pale green	Few brown spots	Large and sparse	Coarse and crunchy	Mild, slightly acid	Low

3.3 Effect of different pollination varieties on internal quality of Qingxiang pear As can be seen from Table 3, except Jincunqiu, the single fruit weight of other varieties is increased to varying degrees after pollination, and the single fruit weight of Xishui is increased most. The fruit shape index of Cuilu and Jincunqiu is 1.039 and 0.921, respectively, and it is extremely significant compared with the fruit shape index of control, and the fruit shape index of other varieties after pollination is not significant compared with the fruit shape index of control. In terms of the ratio of fruit core size to flesh size, it is 0.246 and 0.207 for Xinshiji and Cuilu, respectively, and it is extremely significant compared with the control (0.212); the ratio is not significant for other varieties. Hardness ranges from 4.515 Pa/cm^2 to 5.538 Pa/cm^2, and it is highest (5.538 Pa/cm^2) for Xinshiji and lowest (4.515 Pa/cm^2) for Jincunqiu. The soluble solids content is 9.65% higher than the control, reaching 10.0, and it reaches 11.35% and 11.5% for Xinshiji and Xizilu, respectively. The soluble sugar content is highest (6.507%) for Xizilu, and lowest (4.753%) for Yuanhuang. The titratable acid content ranges from 0.290% to 0.379%, and it is lowest (0.290) for Yuanhuang and Xizilu, followed by Cuiguan and Xishui, and the titratable acid content of Xuehua and Xinshiji is highest. Vc content ranges from 0.562

mg/g to 1.477 mg/g, and it is highest for Yuanhuang and Jincunqiu, followed by Xinshiji, Cuilu and Xishui. With E'li 2, Xinshiji and Xizilu as pollination varieties, Qingxiang pear has the best internal quality, followed by Yuanhuang, Cuiguan, Cuilu and Xishui.

Table 3 Effect of different pollination varieties on internal quality of Qingxiang pear

Pollination varieties	Single fruit weight g	Fruit shape index	Fruit core size flesh size	Hardness Pa/cm^2	Soluble solids %	Soluble sugar %	Titratable acid %	Vc content mg/g
Yuanhuang	305.99 ±45.38^{ab}	0.945 ±0.036^{bc}	0.224^{ab}	4.97^{bcd}	10.6^{bc}	4.753^{b}	0.290^{bcd}	1.477^{a}
Cuiguan	324.13 ±70.91^{ab}	0.941 ±0.068^{bc}	0.211^{b}	4.972^{bcd}	10.4^{c}	5.379^{ab}	0.313^{bcd}	0.706^{bcd}
E'li 2	319.45 ±78.45^{ab}	0.931 ±0.064^{bc}	0.22^{ab}	5.03^{abcd}	10.5^{bc}	6.264^{ab}	0.335^{bcd}	0.706^{bcd}
Xuehua	305.62 ±35.59^{ab}	0.918 ±0.084^{c}	0.237^{ab}	4.858^{bcd}	10.35^{c}	4.869^{ab}	0.379^{bcd}	0.562^{d}
Xinshiji	326.32 ±85.45^{ab}	0.966 ±0.047^{bc}	0.246^{bcd}	5.538^{bcd}	11.35^{ab}	5.689^{ab}	0.379^{bcd}	0.915^{b}
Cuilu	359.87 ±71.39^{bcd}	1.039 ±0.093^{bcd}	0.207^{b}	4.96^{bcd}	10.7^{bc}	6.04^{ab}	0.357^{bcd}	0.899^{b}
Xizilu	353.34 ±52.90^{bcd}	0.995 ±0.052^{ab}	0.229^{ab}	4.919^{bcd}	11.5^{bcd}	6.507^{bcd}	0.290^{bcd}	0.642^{bcd}
Huanghua	331.66 ±33.66^{ab}	0.976 ±0.065^{bc}	0.23^{ab}	5.275^{ab}	10.55^{bc}	6.002^{ab}	0.335^{bcd}	0.770^{bcd}
Xishui	354.79 ±50.75^{bcd}	0.942 ±0.047^{bc}	0.218^{ab}	4.638^{cd}	10.7^{bc}	4.729^{b}	0.313^{bcd}	0.867^{bc}
Jincunqiu	281.66 ±56.71^{b}	0.921 ±0.092^{c}	0.227^{ab}	4.515^{d}	10.7^{bc}	6.457^{bcd}	0.335^{bcd}	1.380^{a}
CK	304.30 ±51.25^{ab}	0.959 ±0.047^{bc}	0.212^{ab}	5.193^{abc}	9.65^{d}	5.229^{ab}	0.335^{bcd}	0.802^{bcd}

Note: SPSS is used for variance analysis of the data in table, and different letters indicate significant difference at the 5% level.

4 Conclusions

Almost all pear varieties are self-incompatible, and there are great differences in compatibility due to variety difference[1]. This test also demonstrates that 10 pear varieties are all compatible with Qingxiang pear, and the fruit-setting rate under artificial pollination is significantly higher than under natural pollination. With Xinshiji as pollination variety, the value of some indicators (single fruit weight, hardness, soluble solids content, soluble sugar content, Vc content) is high, the fruit is sweet and fragrant, and there are few stone cells in the fruit. With Xizilu as pollination variety, the fruit appearance quality is high, the single fruit weight is large and soluble solids and soluble sugar content is high, but the ratio of fruit core size to flesh size and titratable acid content are low. The fruit is sweet and fragrant, and there are few stone cells in the fruit. With Cuiguan as pollination variety, the fruit appearance quality is good, and the value of some indicators (single fruit weight, hardness, soluble solids content, soluble sugar content) is high. With Yuanhuang as pollination variety, the fruit is fine, crisp and sweet, and there are few stone cells in the fruit; the intrinsic quality is similar to the control, but Vc content is high. With Cuilu, Xishui as pollination varieties, the single fruit weight is large and the soluble solids and Vc content is high. Therefore, through comprehensive comparison of different pollination varieties of Qingxiang pear, it is found that Xinshiji, Xizilu, Cuiguan and Yuanhuang can be chosen as the best pollination varieties, followed by Cuilu and Xishui.

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