Diversity and Comparative Evaluation of Fruit Traits of 46 Chinese Cherry Landraces

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Abstract. Chinese cherry [Cerasus pseudocerasus (Lindl). G. Don], belonging to the genus Cerasus, family Rosaceae, is an ancient fruit crop with high economic and ornamental values. Forty-six Chinese cherry landraces from three major distributed regions in China were collected to evaluate the genetic diversity and fruit characteristics. All landraces exhibit rich diversity in main fruit traits, such as peel color, fruit shape and size. The peel shows six different colors with the main color is red and orange-red. The fruit size ranges from 7.68 mm / 7.52 mm (transverse / longitudinal diameter) to 23.01 mm / 22.99 mm (transverse / longitudinal diameter), with the fruit shape index from 0.77 to 1.16. Thirty-one landraces have more than 2.00 grams per fruit, with the largest being 7.10 grams (LYI6), and the smallest being 0.25 grams (SP8). The total soluble solid content is from 9.52% (ZT2) to 18.56% (SP8) among all landraces. XC4 shows the highest vitamin C content (8.05 mg·100mL⁻¹), followed by BJ7a (7.35 mg·100mL⁻¹) and JN1 (6.57 mg·100mL⁻¹). By comprehensive evaluation, these landraces, LYI3, LYI5, WN2, BJ7, BJ7a, ZYW5, XC4, HC, HF, JY4 and PZB, show good and excellent fruit traits, revealing great potentiality for Chinese cherry breeding program.

1. Introduction
Chinese cherry [Cerasus pseudocerasus (Lindl). G. Don] belongs to the genus Cerasus, family Rosaceae, which is an ancient fruit crop with high economic and ornamental values [1-3]. Chinese cherry fluoresces in March and April and sets fruits from May to June [1]. As a traditional fresh fruit with fabulous flavor, the drupes contain rich nutritional ingredients and trace elements, such as vitamins, minerals, fiber and antioxidant compounds for healthy diets [2, 4]. Nowadays, it has become one of the four cherry species used for cultivation and has played an important role in the rural tourist industry in China [5]. The business is also booming throughout its distribution areas because of its alluring daintiness, disease resistance and graceful flowers.

As one of the most famous species providing both fruit and ornamental flower in Cerasus, the cultivation history of Chinese cherry can be traced back over 3000 years [6, 7]. Over the long time of domestication and artificial selection, a large number of landraces with significant phenotypic changes in fruit size, flavor, and fruits shapes have been produced and maintained by local farmers. They often play crucial roles in breeding programs for their wide variability in terms of phenological, morphological, abiotic, biotic, and quality traits [8]. Based on a wide range of resources investigation and evaluation, we found some common defects in current cultivated Chinese cherry, such as small...
fruit size, lack of excellent variety and narrow genetic base [9]. Therefore, it is crucial to select excellent landraces to cultivate new hybrid cultivars in the cherry breeding program.

In this study, 46 Chinese cherry landraces from three major distributed regions in China were collected. Fruit morphological traits were used to distinguish these landraces. We attempt to assess the morphological diversity and identify landraces for in situ preservation and maximize the potential contribution of these deposited variations.

2. Materials and methods

2.1 Plant materials

A total of 46 Chinese cherry landraces were surveyed in the traditional cultivation areas distributing in six provinces in China (Table 1). Among them, 37 were collected in Southwest China (13 in Sichuan, 12 in Yunnan, and 12 in Guizhou) and 9 in East and North China (1 in Anhui, 2 in He'nan, and 6 in Shandong).

Table 1. The information of 46 Chinese cherry accessions used in this study

| Geography            | No. of samples | Location | Code         |
|----------------------|----------------|----------|--------------|
| East and North China Plain | 9 (1, 1, 1, 1, 4, 1) | Taihe, Anhui; Luoyang / Zhengzhou, He'nan; Yantai / Weifang, Shandong | TH2, LY4, CQ7; LAY2, LY13, LY15, LY15a, LY16, CL1 |
| Sichuan Basin        | 13 (1, 1, 1, 2, 2, 3, 2) | Bazhong / Mianyang / Hanyuan / Jianyang / Panzhihua / Pengzhou / Xinjin / Xichang / Yingjing, Sichuan | BZ, TL15, HYHZ, JY4, HC, MY3, PZB, HF, XC1, XC2, XC4, YJ1, YJ2 |
| Yun-Gui Plateau      | 12 (2, 4, 1, 2, 3) | Honghe / Kunning / Mengzi / Yuxi / Zaotong, Yunnan | SP4, SP8, FM2, JN1, ZWY5, YL2, MZ3, YX6, ES1, ZT1, ZT2, ZZ9 |
|                     | 12 (2, 1, 1, 1, 6) | Anshun / Weining / Nayong / Guiyang / Zunyi / Bijie, Guizhou | AS1, PD3, WN2, NY1, GY2, ZY3, BJ2, BJ3, BJ4, BJ6, BJ7, BJ7a |

2.2 Fruit traits detection

Based on the Descriptors and Data Standard for Cherry [10, 11], we evaluated the economic traits of 46 Chinese cherry landraces. Fifty fruits with stalk were randomly collected from each orientation of three vigorous trees. Vernier caliper was used to detect the longitudinal, transverse diameter and stalk length of fruits. Weight per fruit and flesh weight was measured by an electronic balance. Fruit shape index and edible rate was calculated by longitudinal / transverse diameter and flesh / fruit weight, respectively. The content of total soluble solid (TSS) was detected by the hand-held refractometer. 2,6-dichloroindophenol titration method was used to detect the vitamin C content [12]. Total sugar and acid was measured by using anthrone colorimetric [13] and acid-base neutralization method [13].

3. Results

3.1 External fruit traits

Forty-six Chinese cherry landraces exhibit rich diversity in main fruit traits, such as peel color, fruit shape and size (Table 2). There are six peel colors, including orangered, red, vermillion on yellow ground, yellow, purple red, and black purple. The flesh exhibits cream-yellow or cream-white except for TH2 and SP8 with reddish color. Most fruits show kidney, heart, ovate and flat round shape, while fruits of TH2 and TL15 are ellipse. Especially, the 12 Chinese cherry landraces collected from Guizhou province have four kind of fruit shapes. Fruit top shapes consist of concave, flat, convex and sharp. Thirty-one landraces have more than 2.00 grams per fruit, with the largest being 7.10 grams (LY16), and the smallest being 0.25 grams (SP8). The fruit size ranges from to 7.68 mm / 7.52 mm
(transverse/longitudinal diameter) to 23.01 mm / 22.99 mm (transverse/longitudinal diameter), with the fruit shape index from 0.77 to 1.16. The edible rate is from 76.42% (TH2) to 94.63% (BJ7).

We also summarize other fruit characteristics (Table 3). The majority of fruits show flat suture except for eight landraces with concave suture. It is difficult to separate the fruit and stalk for 20 landraces. The longest stalk length (29.52 mm) exhibits the resource from Taihe Anhui, while the shortest one (10.71 mm) is from HongheYunan. The stone longitudinal / transversediameter ranges from 5.23 mm / 4.24 mm (SP8) to 11.71 mm/7.72 mm (BJ4).

3.2 Internal fruit traits
The total soluble solid content is over 14% among 13 Chinese cherry landraces with the range from 9.52% (ZT2) to 18.56% (SP8) among all landraces (Table 4). XC4 shows the highest vitamin C content (8.05 mg·100mL⁻¹), followed by BJ7a (7.35mg·100mL⁻¹) and JN1 (6.57mg·100mL⁻¹). They are significant higher than the remaining accessions (0.72–5.21mg·100mL⁻¹). The total acid content ranges from 0.41 to 2.06mg·100mL⁻¹, which corresponds to BJ7 and LYI3. 19 Chinese cherry landraces have over 10 g·100mL⁻¹ of total sugar, with the maximum and minimum value of 13.41 and 5.95g·100mL⁻¹. By comprehensive evaluation, these landraces, LYI3, LYI5, WN2, BJ7, BJ7a, ZWY5, XC4, HC, HF, JY4 and PZB, show good and excellent fruit traits, revealing great potentiality for cherry breeding program.

4. Discussion
This study evaluates the fruit traits of 46 Chinese cherry landraces from three distributed regions in China. The results indicate that Chinese cherry landraces exhibit rich diversity and variation, such as fruit size, total soluble solid content, and fruit stalk (Tables 2, 3, 4). Recently, Chen et al. [14] suggested that the largest variability of fruits corresponded to the soluble solid content, length of stalk and the fruit size index. Other previous studies [15–17] also indicated that fruit stalk length is the most important characteristics for differentiating cherry germplasm due to its intermediate heritability. Weight per fruit (fruit size) and soluble solid content as the first two parameters involving in domestication process are very important yield components, which can affect the commercial value of fruits for fresh consumption [17]. Chinese cherry, as a long-lived perennial woody plant, has wide geographic distribution in China. During the adaptation of ecologically diverse habitats and the selection of domesticating process, the landraces have probably accumulated considerable genetic variations, such as different fruit colors, fruit size and shape[18]. In addition, Chinese cherry is pollinated by insects and adopts animal-ingested seeds dispersal system [18, 19]. As a result, these features effectively promote the accumulation of genetic diversity and variation.

According to our investigation and analysis, many landraces exhibit great potentiality for cherry breeding program, such as high soluble solid, sugar and vitamin C content. Compared with sweet cherry, Chinese cherry has higher TSS content ranging from 11.0% to 34.0% [4]. Also, it has distinct advantages in adaptation, resistance to pests, productivity and flavor traits. This study found that several landraces, LYI3, LYI5, WN2, BJ7, BJ7a, ZWY5, XC4, HC, HF, JY4 and PZB, can be used to cross breeding of cherry in the future.

Table 2: External fruit quality of 46 Chinese cherry landraces

| Code | Peel color                      | Fruit shape       | Fruit top shape | Weight per fruit /g | Fruit transverse /longitudinal diameter /mm | Fruit shape index | Stone weight /g | Edible rate /% |
|------|--------------------------------|-------------------|-----------------|---------------------|--------------------------------------------|------------------|----------------|---------------|
| TH2  | Black purple                   | Ellipse           | Concave         | 0.67                | 9.83/11.37                                 | 1.16             | 0.16           | 76.42         |
| LY4  | Orange red                     | Heart             | Convex          | 2.63                | 16.66/17.27                                | 1.04             | 0.17           | 93.37         |
| CQ7  | Red                            | Ovate             | Flat            | 0.47                | 9.11/9.03                                  | 0.99             | 0.06           | 86.55         |
| LAY2 | Orange red                     | Heart             | Convex          | 1.97                | 14.38/15.02                                | 1.05             | 0.17           | 91.35         |
| LYI3 | Vermilion on yellow ground     | Heart             | Sharp           | 2.02                | 15.29/16.01                                | 1.05             | 0.14           | 93.20         |
| LYI5 | Orange red                     | Heart             | Convex          | 2.06                | 15.76/14.35                                | 0.91             | 0.14           | 92.98         |
| Code | Color       | Shape       | Size         | Value  |
|------|-------------|-------------|--------------|--------|
| LY15a| Orange red  | Heart       | 6.10         | 20.00/20.71 | 1.04   | 0.14   | 94.15 |
| LY16 | Red         | Heart       | 7.10         | 23.01/22.99 | 1.00   | 0.12   | 91.25 |
| CL1  | Orange red  | Heart       | 1.41         | 12.91/13.09 | 1.01   | 0.08   | 94.23 |
| BZ   | Red         | Ovate       | 0.80         | 10.74/10.01 | 0.93   | 0.09   | 89.12 |
| TL15 | Red         | Ellipse     | 0.30         | 7.63/7.97   | 1.04   | 0.06   | 80.99 |
| HYHZZ| Orange red  | Kidney      | 2.33         | 15.77/13.68 | 0.87   | 0.26   | 88.66 |
| JY4  | Vermilion on yellow ground | Flat round | Concave     | 3.64     | 19.02/16.70 | 0.88   | 0.27   | 92.54 |
| HC   | Orange red  | Kidney      | 2.40         | 16.70/13.23 | 0.79   | 0.17   | 92.81 |
| MY3  | Orange red  | Kidney      | 2.26         | 17.17/14.33 | 0.83   | 0.18   | 92.13 |
| PZB  | Vermilion on yellow ground | Flat round | Concave     | 3.49     | 18.85/16.52 | 0.88   | 0.22   | 93.66 |
| HF   | Purple red  | Heart       | 5.10         | 21.42/21.57 | 1.01   | 0.32   | 93.76 |
| XC1  | Red         | Kidney      | 2.61         | 17.44/13.90 | 0.80   | 0.18   | 93.37 |
| XC2  | Orange red  | Kidney      | 2.12         | 16.24/13.34 | 0.82   | 0.16   | 92.41 |
| XC4  | Vermilion on yellow ground | Flat round | Concave     | 2.17     | 16.59/13.87 | 0.84   | 0.15   | 93.28 |
| YJ1  | Orange red  | Kidney      | 2.20         | 16.40/12.58 | 0.77   | 0.14   | 93.64 |
| YJ2  | Yellow      | Kidney      | 1.75         | 15.71/13.10 | 0.83   | 0.17   | 90.34 |
| SP4  | Vermilion on yellow ground | Flat round | Concave     | 3.05     | 17.89/14.61 | 0.82   | 0.20   | 94.49 |
| SP8  | Red         | Ovate       | 0.25         | 7.68/7.52   | 0.98   | 0.04   | 82.53 |
| FM2  | Vermilion on yellow ground | Heart      | Sharp       | 1.91     | 15.04/14.96 | 0.99   | 0.18   | 91.18 |
| JN1  | Orange red  | Ovate       | 0.37         | 8.00/7.73   | 0.97   | 0.05   | 85.09 |
| ZWY5 | Red         | Near round  | 0.93         | 8.11/7.72   | 0.95   | 0.06   | 93.39 |
| YL2  | Orange red  | Kidney      | 2.29         | 16.63/13.83 | 0.83   | 0.16   | 92.98 |
| MZ3  | Red         | Kidney      | 2.70         | 17.27/14.96 | 0.87   | 0.18   | 93.37 |
| YY6  | Orange red  | Heart       | 2.81         | 16.39/15.36 | 0.94   | 0.18   | 93.74 |
| ES1  | Orange red  | Kidney      | 2.79         | 16.89/15.73 | 0.93   | 0.19   | 93.26 |
| ZT1  | Red         | Heart       | 2.10         | 15.17/14.71 | 0.97   | 0.20   | 91.47 |
| ZT2  | Orange red  | Kidney      | 1.93         | 14.82/12.93 | 0.87   | 0.17   | 91.10 |
| ZZ9  | Orange red  | Ovate       | 1.26         | 12.39/12.18 | 0.98   | 0.11   | 91.67 |
| AS1  | Red         | Flat round  | 3.32         | 18.49/16.77 | 0.91   | 0.27   | 91.83 |
| PD3  | Red         | Ovate       | 3.44         | 18.41/16.86 | 0.92   | 0.27   | 92.27 |
| WN2  | Red         | Heart       | 2.53         | 17.53/16.74 | 0.96   | 0.19   | 92.34 |
| NY1  | Red         | Kidney      | 2.50         | 16.59/14.94 | 0.90   | 0.16   | 94.16 |
| GY2  | Purple red  | Kidney      | 0.49         | 8.68/9.70   | 0.90   | 0.08   | 84.49 |
| ZY3  | Orange red  | Ovate       | 2.59         | 16.95/15.37 | 0.91   | 0.21   | 91.83 |
| BJ2  | Red         | Ovate       | 2.68         | 16.65/15.22 | 0.91   | 0.17   | 94.32 |
| BJ3  | Orange red  | Flat round  | 5.59         | 22.27/19.71 | 0.89   | 0.37   | 93.36 |
| BJ4  | Red         | Ovate       | 4.24         | 19.32/20.01 | 1.04   | 0.26   | 94.37 |
| BJ6  | Vermilion on yellow ground | Ovate | Convex     | 1.99      | 16.89/15.79 | 0.94   | 0.18   | 91.07 |
| BJ7  | Vermilion on yellow ground | Kidney | Flat       | 2.17      | 15.90/15.10 | 0.95   | 0.12   | 94.63 |
| BJ7a | Red         | Flat round  | 2.25         | 16.25/13.59 | 0.84   | 0.15   | 93.28 |
## Table 3. Fruit characteristics of 46 Chinese cherry landraces

| Code  | Suture | Difficult degree of separation between fruit and stalk | Stone texture | Fruit stalk length/coarseness /mm | Stone longitudinal/transverse diameter /mm |
|-------|--------|--------------------------------------------------------|---------------|-----------------------------------|--------------------------------------------|
| TH2   | Flat   | Difficult                                              | None          | 29.52/1.12                        | 9.23/6.05                                  |
| LY4   | Flat   | Difficult                                              | Available     | 16.54/1.47                        | 10.08/6.98                                 |
| CQ7   | Flat   | Difficult                                              | None          | 24.81/0.78                        | 6.97/4.56                                  |
| LAY2  | Flat   | Difficult                                              | Available     | 17.88/1.08                        | 9.71/6.80                                  |
| LY13  | Flat   | Easy                                                   | Available     | 14.49/0.92                        | 8.76/6.63                                  |
| LY15  | Flat   | Easy                                                   | Available     | 17.82/1.24                        | 7.54/6.41                                  |
| LY15a | Flat   | Difficult                                              | Available     | 18.59/1.03                        | 9.62/6.55                                  |
| LY16  | Concave| Difficult                                              | Available     | 18.70/1.33                        | 7.90/6.01                                  |
| CL1   | Flat   | Middle                                                 | Available     | 24.91/0.85                        | 7.91/5.75                                  |
| BZ    | Flat   | Middle                                                 | None          | 18.58/1.11                        | 7.13/5.44                                  |
| TL15  | Flat   | Easy                                                   | Available     | 14.41/0.73                        | 6.09/4.55                                  |
| HYHZZ | Flat   | Difficult                                              | Available     | 12.54/1.95                        | 8.65/8.04                                  |
| JY4   | Flat   | Middle                                                 | Available     | 15.30/1.55                        | 10.44/9.31                                 |
| HC    | Flat   | Easy                                                   | Available     | 16.27/1.43                        | 7.75/7.70                                  |
| MY3   | Flat   | Middle                                                 | Available     | 15.65/1.37                        | 7.41/7.35                                  |
| PZB   | Concave| Difficult                                              | Available     | 14.98/2.01                        | 8.69/8.13                                  |
| HF    | Flat   | Difficult                                              | Available     | 18.99/3.93                        | 12.09/8.07                                 |
| XC1   | Flat   | Middle                                                 | Available     | 17.35/1.15                        | 7.64/7.91                                  |
| XC2   | Flat   | Middle                                                 | Available     | 15.42/1.32                        | 7.42/7.46                                  |
| XC4   | Flat   | Easy                                                   | Available     | 17.51/1.11                        | 7.25/7.09                                  |
| YJ1   | Flat   | Middle                                                 | Available     | 13.47/1.62                        | 6.85/6.67                                  |
| YJ2   | Concave| Difficult                                              | Available     | 17.70/1.23                        | 7.85/6.98                                  |
| SP4   | Flat   | Easy                                                   | Available     | 13.50/1.57                        | 7.83/7.94                                  |
| SP8   | Flat   | Easy                                                   | Available     | 10.71/0.91                        | 5.23/4.24                                  |
| FM2   | Flat   | Difficult                                              | Available     | 13.42/1.42                        | 8.61/6.88                                  |
| JN1   | Concave| Middle                                                 | None          | 14.27/0.95                        | 6.09/5.04                                  |
| ZYW5  | Flat   | Middle                                                 | None          | 14.48/0.78                        | 5.67/4.86                                  |
| YL2   | Flat   | Difficult                                              | Available     | 14.84/1.26                        | 7.10/7.18                                  |
| MZ3   | Flat   | Middle                                                 | Available     | 13.62/1.56                        | 7.99/7.75                                  |
| YX6   | Flat   | Difficult                                              | Available     | 11.77/1.40                        | 7.75/7.03                                  |
| ES1   | Concave| Difficult                                              | Available     | 11.99/1.43                        | 7.98/6.84                                  |
| ZT1   | Concave| Difficult                                              | Available     | 19.66/1.15                        | 8.24/7.48                                  |
| ZT2   | Flat   | Middle                                                 | Available     | 17.25/1.10                        | 7.68/6.86                                  |
| ZZ9   | Flat   | Difficult                                              | Available     | 17.09/1.02                        | 8.16/6.14                                  |
| AS1   | Flat   | Easy                                                   | Available     | 18.82/1.28                        | 10.34/8.24                                 |
| PD3   | Flat   | Middle                                                 | Available     | 14.86/1.50                        | 10.61/8.06                                 |
| WN2   | Flat   | Middle                                                 | Available     | 18.41/1.19                        | 7.94/7.30                                  |
| NY1   | Concave| Difficult                                              | Available     | 16.08/1.06                        | 8.07/6.89                                  |
| ZY3   | Flat   | Middle                                                 | Available     | 15.83/1.43                        | 8.19/7.52                                  |
| GY2   | Flat   | Middle                                                 | None          | 14.19/0.98                        | 6.14/5.25                                  |
| BJ2   | Flat   | Middle                                                 | Available     | 17.54/1.06                        | 7.97/6.78                                  |
| BJ3   | Flat   | Easy                                                   | Available     | 19.17/1.67                        | 11.06/9.71                                 |
| BJ4   | Concave| Difficult                                              | Available     | 20.50/1.47                        | 11.71/7.72                                 |
| BJ6   | Flat   | Difficult                                              | Available     | 16.11/1.18                        | 7.79/7.12                                  |
| BJ7   | Flat   | Difficult                                              | Available     | 15.26/1.00                        | 7.55/6.49                                  |
Table 4. Internal fruit quality of 46 Chinese cherry landraces

| Code | Soluble solid/% | Soluble sugar/% | Titratable acid/% | Vitamin C /mg·100mL⁻¹ | TSS-acid ratio | Taste     | Eating quality |
|------|----------------|----------------|------------------|------------------------|----------------|-----------|---------------|
| TH2  | 18.15          | 12.32          | 1.41            | 5.21                   | 12.84          | Sweet-sour | Medium        |
| LY4  | 11.14          | 10.89          | 0.67            | 1.11                   | 16.74          | Sour-sweet | Good          |
| CQ7  | 13.82          | 8.95           | 0.87            | 1.11                   | 15.80          | Sour-sweet | Good          |
| LAY2 | 10.78          | 10.27          | 0.87            | 1.63                   | 12.35          | Sweet-sour | Medium        |
| LYI3 | 17.70          | 10.62          | 2.06            | 1.76                   | 8.61           | Sour      | Poor          |
| LY15 | 12.80          | 9.45           | 0.94            | 1.89                   | 13.57          | Sweet-sour | Medium        |
| LYI5a| 12.38          | 7.97           | 0.64            | 0.91                   | 19.34          | Sour-sweet | Good          |
| LY16 | 12.08          | 10.48          | 0.54            | 1.11                   | 22.37          | Sweet     | Excellent     |
| CL1  | 15.64          | 13.41          | 0.71            | 4.68                   | 21.95          | Sweet     | Excellent     |
| BZ   | 12.24          | 8.90           | 0.78            | 1.11                   | 15.64          | Sour-sweet | Good          |
| TL15 | 17.58          | 11.78          | 1.15            | 0.98                   | 15.29          | Sour-sweet | Good          |
| HYHZZ| 11.48          | 10.22          | 1.26            | 0.91                   | 9.08           | Sour      | Poor          |
| JY4  | 13.78          | 8.60           | 0.82            | 3.38                   | 16.79          | Sour-sweet | Good          |
| HC   | 17.48          | 11.71          | 0.95            | 0.98                   | 18.37          | Sour-sweet | Good          |
| MY3  | 11.70          | 8.68           | 0.99            | 0.85                   | 11.82          | Sweet-sour | Medium        |
| PZB  | 14.56          | 10.16          | 1.65            | 1.95                   | 8.82           | Sour      | Poor          |
| HF   | 12.50          | 7.81           | 0.43            | 4.55                   | 29.39          | Sweet     | Excellent     |
| XC1  | 10.26          | 7.71           | 0.71            | 1.69                   | 14.45          | Sour-sweet | Good          |
| XC2  | 11.72          | 9.39           | 0.98            | 0.98                   | 12.01          | Sour-sweet | Medium        |
| XC4  | 15.04          | 9.74           | 0.81            | 8.05                   | 18.57          | Sour-sweet | Good          |
| YJ1  | 11.14          | 8.83           | 0.84            | 3.77                   | 13.29          | Sweet-sour | Medium        |
| YJ2  | 11.40          | 7.64           | 0.64            | 4.10                   | 17.93          | Sour-sweet | Good          |
| SP4  | 13.50          | 8.90           | 1.13            | 1.82                   | 11.95          | Sour-sweet | Medium        |
| SP8  | 18.56          | 10.25          | 1.38            | 2.08                   | 13.42          | Sour-sweet | Medium        |
| FM2  | 14.16          | 10.66          | 0.60            | 0.72                   | 23.60          | Sweet     | Excellent     |
| JN1  | 17.26          | 9.92           | 1.30            | 6.57                   | 13.29          | Sour-sweet | Medium        |
| ZYW5 | 16.70          | 11.66          | 1.55            | 2.54                   | 10.74          | Sour-sweet | Medium        |
| YL2  | 10.78          | 8.14           | 0.56            | 1.82                   | 19.37          | Sour-sweet | Good          |
| MZ3  | 9.88           | 6.07           | 0.71            | 0.98                   | 13.92          | Sour-sweet | Good          |
| YX6  | 11.66          | 9.63           | 0.61            | 2.60                   | 19.20          | Sour-sweet | Good          |
| ES1  | 12.14          | 10.87          | 0.90            | 0.98                   | 13.49          | Sour-sweet | Good          |
| ZT1  | 12.7           | 11.57          | 0.73            | 1.50                   | 17.40          | Sour-sweet | Good          |
| ZT2  | 9.52           | 7.93           | 0.74            | 1.04                   | 12.85          | Sour-sweet | Medium        |
| ZZ9  | 12.66          | 11.60          | 0.74            | 1.24                   | 17.09          | Sour-sweet | Good          |
| AS1  | 12.34          | 6.34           | 1.37            | 4.36                   | 9.00           | Sour      | Poor          |
| PD3  | 9.62           | 7.60           | 0.91            | 0.98                   | 10.57          | Sour-sweet | Medium        |
| WN2  | 16.52          | 12.03          | 1.57            | 1.95                   | 10.50          | Sour-sweet | Medium        |
| NY1  | 12.60          | 9.57           | 0.78            | 0.91                   | 16.15          | Sour-sweet | Good          |
| GY2  | 16.78          | 10.47          | 1.13            | 1.11                   | 14.85          | Sour-sweet | Good          |
| ZY3  | 9.74           | 8.25           | 0.49            | 1.82                   | 20.07          | Sweet     | Excellent     |
| BJ2  | 10.48          | 8.25           | 0.57            | 0.98                   | 18.39          | Sour-sweet | Good          |
| BJ3  | 10.04          | 5.95           | 1.04            | 2.02                   | 9.69           | Sour      | Poor          |
| BJ4  | 12.18          | 9.07           | 0.69            | 0.91                   | 17.65          | Sour-sweet | Good          |
| BJ6  | 12.20          | 9.28           | 0.65            | 0.98                   | 18.81          | Sour-sweet | Good          |
BJ7  12.70  12.05  0.41  0.72  31.23  Sweet  Excellent
BJ7a  10.96  7.21  1.09  7.35  10.06  Sweet-sour  Medium

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