Effects of Formulated Fertilization on Fruit Quality of Early Ripe Peach 'Beijing 2'

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Abstract. The early ripe peach ‘Beijing 2’ in Shanquan Town, Longquanyi District, Chengdu City, Sichuan Province of China was used as the material to study the effects of formulated fertilization on the fruit quality of peach. Compared with the control, each treatment had the effect on the quality of ‘Beijing 2’ peach fruit. Base fertilizer of organic fertilizer 600 kg/667m², urea 12-20 kg/667m², monoamine phosphate 24 kg/667m², superphosphate 80 kg/667m², potassium sulfate 56 kg/667m²; germination fertilizer application borax 6 kg/667m², urea 10 kg/667m²; hard-core fertilizer compound fertilizer 40 kg/667m², potassium sulfate 20 kg/667m² had the best effect, making ‘Beijing 2’ peach single fruit weight, hardness, TSS, total sugar and VC increased by 21.97%, 320%, 21.33%, 15.69% and 54.01%, respectively, compared with the control. By formulated fertilization, the application of organic fertilizer 600 kg/667m², fertilizer reduction 80-96 kg/667m², fertilizer application decreased by 23.53%-28.24%, and improved the fruit quality of ‘Beijing 2’ peach.

1. Introduction
The main producing area of Sichuan Peach is Chengdu, with an area of 24,333.3 hectares, which occupies half of the peach industry in Sichuan Province. It is further important to realize the ecological and standardized production of Sichuan peach and improve the safety and quality of fruit. However, at present, there are many phenomena of unfertilized fertilizer, variety characteristics, ecological characteristics and yield fertilization in peach production in China, which results in excessive or insufficient fertilization and the imbalance of soil and plant nutrition [1]. Especially in recent years, the application of organic fertilizer has been reduced, contempt organic, phosphorus and potassium, and partial element and medium amount of irrational fertilization cause soil compaction, acidification, salinization, fruit deficiency and other issues [2]. These have become the main problems that restrict the quality of peaches.

This study aim at rationally formulating a formula for fertilization in Longquanyi District, Chengdu City, Sichuan Province, where the standards of abuse of fertilizers were not uniform and the fertilization period was not standardized. Studying the combination of organic fertilizer and inorganic fertilizer, increasing the application of organic fertilizer, reducing the effect of chemical fertilizer on the fruit quality of early-ripening peach ‘Beijing 2’ and the physical and chemical properties of peach garden soil, and reducing the application rate of chemical fertilizer by 20%-30% through chemical...
fertilizer reduction. It provides a certain theoretical and practical basis for the quality improvement and efficiency of peach, and also lays a foundation for formulating a balanced fertilization system.

2. Materials and methods

2.1 Materials

The tested variety was 5-year-old 'Beijing 2' peach with consistent growth and robust growth. Its cultivar characteristics are large fruit, good coloration, high hardness, storage and transportation, and the mature fruit hangs the tree for about 10 days to maintain the same quality. It does not drop fruit before harvesting [3]. Using open field cultivation, the planting density of 667 m$^2$ was 40.

The test site is located in Shanquan Town, Longquanyi District, Chengdu. It is a subtropical humid climate. The landform is mainly shallow hills. It is affected by the Longquan Mountains and forms an independent microclimate area. The climate is mild and humid throughout the year, with four distinct seasons and abundant rainfall [4]. The average annual precipitation is 895.6 mm, the annual average pressure is 956.4 hpa (hundreds of pascals), the annual average relative humidity is 81%, the average annual sunshine hours are 1032.9h, the annual average wind speed is 1m/s, and the wind direction is mostly north. The wind is 46% and the annual average frost-free period is 297 days.

Basic physical and chemical properties of the soil at the test site: The soil in the test site is a limestone sandstone deposit. Organic matter content 23.15 g/kg, pH 6.34, total nitrogen content 1.05 g/kg, available nitrogen content 122.4 mg/kg, total phosphorus 495 mg/kg, available phosphorus content 16.20 mg/kg, total potassium content 24.73 mg/kg. The available potassium content is 72.73 mg/kg, the exchangeable calcium content is 419 mg/kg, and the exchangeable magnesium content is 147 mg/kg.

Test fertilizer: urea (N content 46%), organic fertilizer (main ingredient is dried chicken manure), potassium sulfate (K$_2$O content 50%), monoammonium phosphate (P$_2$O$_5$ content 46%, N content 12%), superphosphate (P$_2$O$_5$ content 12%).

2.2 Experimental design

The experiment controlled the yield of 1500-2000 kg/667m$^2$. The base fertilizer was applied from the end of September to the beginning of October. According to the previous study of the research group, urea was 0.3, 0.4, 0.5kg/plant, and potassium sulfate was 1.3, 1.4 and 1.5 kg/plant. There is a total of 9 levels are combined. The local conventional fertilization is used as a control, and a total of 10 treatments are used. The other fertilizers were applied in the same amount, that is 15 kg/plant of organic fertilizer, 0.6 kg/sodium phosphate, and 2 kg/strain of superphosphate; the sprouting fertilizer was 10-15 days before flowering (from the end of February to the beginning of March), urea is applied according to 0.25 kg/plant and borax 0.15 kg/plant; pre-harvest fertilizer is applied 15 days before harvest (from the end of May to the beginning of June), and the compound fertilizer is applied together with potassium sulfate. The local conventional fertilization applied 2.50 kg/plant of compound fertilizer in the sprouting fertilizer and pre-harvesting fertilizer, and the base fertilizer was applied with organic fertilizer 5.00 kg/plant +compound fertilizer 3.00 kg/plant +urea 0.5 kg/plant. Compared with local conventional fertilization, it increased the application of organic fertilizer by 400kg/667 m$^2$ and the reduction of chemical fertilizer by 80-96 kg/667 m$^2$.

The fruits were randomly collected from four directions in the south, east, north and west of the canopy at fruit maturity for fruit quality determination. The weight of single fruit was measured by electronic balance; The weight of single fruit was measured by electronic balance; the longitudinal diameter and transverse diameter of the fruit were measured by vernier caliper, and the fruit shape index was calculated; the soluble solids content was determined by digital hand-held soluble solids analyzer; the total sugar content was determined by Feili liquid redox titration; total acid content was determined by acid-base neutralization titration; VC content was determined by 2, 6-dichloroindophenol titration [5].
2.3 Statistical analysis
Statistical analysis was conducted using SPSS 18.0 statistical software. Data analysis by one-way ANOVA with least significant difference at 5% confidence level.

3. Results
All treated single fruit removal treatments were higher than the control (Table 1), with the maximum single fruit weight of treatment 5 reaching 103.8 g, which was 180.15% higher than the control (P < 0.05). There was no significant difference between the fruit shape index treatment and the control. Treatments 4, 5, 6, 8, and 9 were significantly higher in fruit firmness than the control, with a maximum hardness of 0.63 kg/cm², which was 320% higher than the control (P < 0.05). The TSS of each treatment was higher than the control except that the treatment 3, and the treatment 5 was increased by 21.33% (P < 0.05). The total sugar and VC content of each treatment were significantly higher than the control. The highest total sugar reached 14.23%, which was 18.29% higher than the control, and the highest VC reached 2.11 mg/100g, which was 54.01% higher than the control. Below the control except that the treatment 3, and the treatment 5 was significantly higher than the control except that the treatment 3, and the treatment 5 was 17.50% higher than the control (P < 0.05). The solid acid ratio of treatments 2 and 4 was higher than that of the control, with treatment 2 being the highest and 17.50% higher than the control (P < 0.05).

Table 1. Effect of different treatments on the quality of 'Beijing 2' peach fruit

| Treatments | Weight (g) | Fruit shape index | Hardness (kg/cm²) | TSS (%) | Total sugar (mg/100g) | VC (mg/100g) | Total acid (%) | Solid acid ratio |
|------------|------------|-------------------|-------------------|--------|-----------------------|--------------|---------------|----------------|
| CK         | 85.1d      | 1.13a             | 0.15d             | 15.0d  | 12.03d                | 0.36d        | 57.7cd        |                |
| 1          | 91.9c      | 1.11a             | 0.18d             | 15.3d  | 13.73b                | 1.61c        | 58.1e         |                |
| 2          | 97.0b      | 1.08a             | 0.17d             | 15.6e  | 13.73b                | 1.71c        | 67.8a         |                |
| 3          | 98.2b      | 1.09a             | 0.28c             | 15.0d  | 13.44b                | 1.71c        | 55.6d         |                |
| 4          | 97.6b      | 1.11a             | 0.63a             | 17.5a  | 14.23a                | 1.91a        | 59.7b         |                |
| 5          | 103.8a     | 1.07a             | 0.52a             | 18.2a  | 14.07a                | 2.07a        | 57.5cd        |                |
| 6          | 96.3b      | 1.03a             | 0.57a             | 17.1a  | 13.92a                | 2.11a        | 51.8e         |                |
| 7          | 72.6e      | 1.08a             | 0.18d             | 15.5c  | 12.62b                | 1.71b        | 47.0 fg       |                |
| 8          | 88.7d      | 1.06a             | 0.27c             | 16.1b  | 13.06a                | 1.81b        | 48.8f         |                |
| 9          | 85.4d      | 1.13a             | 0.41b             | 15.8c  | 12.01c                | 1.71c        | 45.6 g        |                |

Note: The lowercase letters in the table indicate the difference in the same column data at the 0.05 level.

4. Discussion
Peach is a kind of hi-fertilizer species [6]. Combining the growth characteristics of peaches with the law of fertilizer requirement, the scientific soil testing formula fertilization is carried out according to local conditions, and the phenomenon of partial application of nitrogen fertilizer and organic fertilizer is rarely changed. In the whole growth process of peach, the organic fertilizer is emphasized in autumn, and nitrogen fertilizer is the main application in the early growth season. The application of phosphorus and potassium fertilizer in fruit growth period can effectively improve soil physical and chemical properties and improve fruit quality. The results are consistent with other studies [7].

For the 'Beijing 2' peach, comprehensive consideration of the amount of fertilizer application, soil nutrient change trend, fruit quality indicators and other data, we believe that the best amount of fertilizer was: organic fertilizer application of 600 kg/667m², urea 12-20 kg/667 m², monoamine phosphate 24 kg/667m², superphosphate 80 kg/667m², potassium sulphate 56 kg/667m²; germination fertilizer application borax 6 kg/667 m², urea 10 kg/667m²; hard core fertilizer compound fertilizer 40 kg/667m², potassium sulfate 20 kg/ 667 m². The total application amount is: organic fertilizer 600 kg/667 m², urea 22-30 kg/667 m², monoamine phosphate 24 kg/667 m², superphosphate 80 kg/667m², potassium sulfate 76 kg/667m², borax 6 kg/667m², compound fertilizer 40 kg/667m² was the best. Through soil testing and formula fertilization, organic fertilizer increased by 400 kg/667m², fertilizer...
decreased by 80-96 kg/667m², and fertilizer application decreased by 23.53%-28.24%, which effectively achieved the effect of reducing fertilizer and increasing efficiency in peach industry.

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