Pruning During June Promoting Blueberry Branches Growth and Flower Buds Formation

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Abstract. In this experiment, the growth status and flower bud differentiation of blueberry plants were studied after pruning the second or third buds at the top of the sprouting branches in the northern highbush blueberry cultivar ‘Brigitta’ in southwestern China. The results showed that there was no significant difference in the number of blueberries per plant between pruning and non-pruning. The number of florets per panicle was significantly increased, which signified more fruits per panicle, and increased fruit yield. In addition, the morphological differentiation of flower buds of blueberries was delayed after pruning.

1. Introduction
Blueberry is a new fruit tree species with high economic value and broad development prospects. Blueberry fruit is famous all over the world because it is rich in nutrients and a variety of health ingredients[1]. It is recommended as one of the five healthiest fruits by the Food and Agriculture Organization of the United Nations (FAO)[2]. It is known as the "golden berry". In recent years, with the continuous improvement of people's living standards, people pay more and more attention to health. Therefore, blueberry, a fruit tree with strong health care function, is favored by people and the planting area of blueberry in southwestern China has increased year by year. Among them, the northern highbush blueberry cultivar ‘Brigitta’ is medium in height and is one of the excellent varieties suitable for fresh food because of its large fruit, high yield and moderate sour and sweet taste[3]. However, it is observed that the pruning techniques of many blueberry orchards in southwestern China are not in place, and the management is relatively extensive[4]. There are some problems in cultivation, such as low fruit setting rate, low blueberry yield, poor fruit quality and so on. Pruning is one of the key links in blueberry cultivation and management. Previous studies have shown that pruning can effectively improve the tree potential of blueberries and regulate the relationship between reproductive growth and vegetative growth, thus affecting the growth of new branches and the formation of flower buds[5-6]. The formation of blueberry yield is closely related to flower bud formation, flower bud quantity and quality[7]. Increasing the number and quality of flower buds can effectively increase blueberry yield.

In order to improve the yield and quality of blueberry, the effect of pruning (the second or third bud at the top of bud) on the growth and development of blueberry was studied in this experiment, so as to
provide scientific basis for improving the yield and quality of blueberry and perfecting the pruning technology of blueberry.

2. Materials and methods

2.1. Research sites and plant materials
This experiment was conducted in Pujiang Blueberry Valley in Chengdu, Sichuan Province, China, which is co-studied by Sichuan Agricultural University. It is located at 30°20′ N, 103°19′ E, 594 - 609 meters above sea level. The average annual temperature of 16 ℃ and the annual accumulated temperature above 10 °C is 4700 – 5300 °C. The average annual precipitation is 1266 mm, annual sunshine duration is 1042 - 1412 h, and the frost-free period is 278 d.

The northern highbush blueberry cultivar ‘Brigitta’ was selected as the experimental material. The selected blueberry plants grew healthily, grew basically the same, and carried on the routine management in the field. In 2019, the plant was the 5-year-old plant, and the plant spacing was 2 × 1 m apart.

2.2. Experimental design and treatments
In this experiment, we set up the treatment (D) of pruning the first 2 or 3 buds at the top of the ecology of sprouting branches, and taking the conventional pruning management as the control (CK). The pruning time was after the end of the harvest period in June 2019. In this experiment, 5 branches of a single plant were used as plots, and 3 repeats were set up.

2.3. Observation on the morphology of flower bud
From the pruning day, 30 sprouts were taken every 7 days in the treatment group and the control group, and the materials were taken from the first to third buds at the top of the morphology for a total of four times. The morphology of flower bud differentiation was observed by paraffin section method[7], and the specific collection time was June 19, June 25, July 2 and July 9, 2019. The number of flowers per bud, new branches and leaves were investigated on April 15, 2020.

2.4. Statistical analysis
One-way analysis of variance (ANOVA) and the Student–Newman–Keuls q test were performed at the 5 % significance level with IBM SPSS Statistics 19.0 software (IBM Corporation, Armonk, NY, USA).

3. Results

3.1. Effect of pruning on branch formation and flower bud quantity

Note: different letters in the same column indicate significant differences (P < 0.05).

Figure 1. Effect of pruning on branch formation and flower bud quantity
According to Fig 1. Fruits, compared with unpruned branches, the number of flower bud of blueberry branches (0.64 ± 0.20) decreased significantly after pruning, while the number of flowers per bud (3.15 ± 0.57) increased significantly, but there was no significant difference in the total number of flowers on branches (2.02 ± 0.11). The number of flower buds on blueberry branches in the control group was 1.30 ± 0.28, the number of flowers per bud was 1.78 ± 0.30, and the total number of flowers on each branch was 2.31 ± 0.08. According to Fig 1. Leaves, compared with the control group, the number of newly growing branches of blueberry plants (0.79 ± 0.11) decreased significantly after pruning, the number of leaves per branch (4.11±1.23) had no significant difference, and the total number of leaves (3.26 ± 0.14) decreased significantly. The number of newly growing branches in the control group was 1.40 ± 0.36, the number of leaves per branch was 4.82 ± 0.60, and the total number of leaves was 6.75 ± 0.21.

3.2. Observation on the morphology of flower bud differentiation of blueberry

Figure 2. Flower bud structure of blueberry in different periods
The growth and development of flower buds of blueberry were observed by paraffin section. The results showed that in the flower buds collected on June 19, the flower buds in the control group were in the undifferentiated stage, the bud scales clasped closely, the cells in the growth point were small and arranged tightly, and the development process of flower buds in the experimental group was slower than that in the control group. The flower buds collected on June 25 in both the control group and the treatment group were also in the undifferentiated stage, the bud scales clasped closely, the growth cone section was conical, and the tip was sharp. In the flower buds collected on July 2, the growth point of flower buds in the control group increased from conical to arc-shaped, the distance between scales around the growth point increased, and entered the stage of flower bud differentiation, while the flower buds in the treatment group were still in the undifferentiated stage. In the flower buds collected on July 9, the growth point of flower buds in the control group was hypertrophic, the cells were larger, and the flower buds further differentiated, while in the experimental group, the growth point of flower buds gradually rounded to a circular arc, the cell volume increased, and entered the stage of flower bud differentiation. Therefore, the flower buds in the control group entered the stage of flower bud differentiation earlier than those in the experimental group, and the process of flower bud development was faster in the control group.

4. Conclusion
The purpose of this experiment was to study the effects of pruning sprouting branches after harvest on plant growth and flower bud differentiation of blueberry. The results showed that although there was no significant difference in the number of fruits per plant between pruning sprouting branches after harvest and non-pruning branches under conventional management, there was a significant increase in the number of flowers per bud and the amount of seed setting per bud. At the same time, the morphological observation of flower bud differentiation showed that the process of flower bud growth and differentiation of blueberry changed because pruning adjusted the relationship between plant vegetative growth and reproductive growth. After pruning, the differentiation period of flower bud morphology of blueberry was delayed. The results provide a basis for scientific pruning of blueberries in southwestern China, and confirm the important role of bud pruning in increasing the yield of blueberries. Through the analysis of flower bud morphology of blueberry, it is helpful to reveal the flower formation mechanism of blueberry and provide a theoretical basis for the theoretical study of blueberry flower formation.

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