Effects of Crop Straw on the Plant Height, Stem Diameter and Soluble Sugar Content of Peach (*Amygdalus davidiana*) Seedlings

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Abstract: The study of the effects of adding different crop (rape, rice, wheat, and maize) straw to the soil on the plant height, stem diameter and soluble sugar of peach (*Amygdalus davidiana*) seedlings were studied. The plant height and stem diameter of the peach seedlings treated with rape straw were the largest, 27.09 cm and 3.24 mm, respectively, and the plant height increased by 20.51% compared with the control. The soluble sugar contents in roots, leaves of peach seedlings treated with wheat straw were the highest, which were 78.14 mg/g and 97.74 mg/g, respectively. Therefore, soil covering of rape straw was beneficial to the growth of plant height and stem diameter of peach seedlings, and the accumulation of soluble sugar content of peach seedlings treated with wheat straw was the best.

1 INTRODUCTION

As an economic resource, straw is the product of agricultural crops, and the people pay more and more attention to the utilization of straw, and many utilization methods of straw have been invented, among which the most important one is returning straw to the field (Yin 2021). In recent years, a large number of straw burning has occurred in the world, however the choice of straw burning not only wastes resources, but also pollutes the environment (Yin 2021, Wu 2021). The crop straw is mainly used for rice, wheat, maize, beans and tubers, which can be used on a large scale because of their extensive sources (Wu 2021). Many scholars have studied the use of rape straw in rice fields can bring huge economic benefits (Zhang 2021, He 2021). Straw is rich in some specific nutrient elements and nutrients, under certain conditions, these elements and nutrients with the rotten straw into the soil to be absorbed by the plant use (An 2021, Gao 2021). Many studies have shown that the straw of rape, maize, rice and wheat can promote the growth of plants (An 2021, Gao 2021, Chen 2021), and the application of rape straw can also increase the content of soluble sugar in maize (An 2021).

Peach (*Amygdalus davidiana*) is a small deciduous tree belonging to the genus *Prunus* in the family Rosaicaceae (Chen 2021). Peach has very strong tolerance, such as salt tolerance, alkali resistance and cold resistance, which is often used as the rootstock (Wang 2021). The stro ng adaptability of peach makes people pay more and more attention to it, and there are more and more studies on it, and most of them are to study the benefits brought by peach as a graft material (Wang 2021, Xiang 2019). Peach plays an important role in returning farmland to forest, restoring soil and greening (Wu 2020, Benedikt 2020). In this study, we added the straw of rape, rice, wheat, and maize on to the soil, and planted peach seedlings, and the effects of crop straw on the growth and soluble sugar

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content of peach seedlings were studied. The aim of this study was screened out the best crop straw that could promote the growth of peach seedlings, and provide reference for peach production.

2 MATERIALS AND METHODS

2.1 Materials

The seeds of *Amygdalus davidiana* were purchased from the market. The seeds were germinated and transplanted to a plastic basin containing perlite. Rape, rice, wheat and maize straw were collected in the fields around Sichuan Agricultural University, dried and crushed for reserve use. The soil was fluvial soil, taken from the farmland around Chengdu Campus of Sichuan Agricultural University. The basic physical and chemical properties of soil were: pH 7.71, organic matter 22.38 g/kg, total nitrogen 1.75 g/kg, total phosphorus 10.25 g/kg, total potassium 11.32 g/kg, alkali-hydrolyzable nitrogen 87.99 mg/kg, available phosphorus 55.78 mg/kg, available potassium 41.96 mg/kg.

2.2 Experimental Design

The pot experiment was conducted at the Chengdu Campus of Sichuan Agricultural University from April to October 2019. Perlite was installed in 50-hole high-bottom hole tray for seedling cultivation, and the chassis was irrigated with 1 L Hoagland nutrient solution, which was changed every three days, and cultured day and night in an artificial climate chamber between 21°C and 23 °C. Air dried and crushed the soil, passed through a 5 mm sieve, and filled each plastic basin (20 cm high, 20 cm diameter) with 3.0 kg of air dried soil. The experiment consisted of five treatments, including rape straw, rice straw, wheat straw, maize straw and no straw (control). The proportion of straw added to each pot of soil was 10 g/kg, and the mixture was evenly mixed. Each treatment was repeated 4 times (4 pots). All potted plants were watered daily, always maintaining soil moisture at 80% of field capacity, and transplanted the peach seedlings after two weeks. In early May 2019, when the seedlings grow to 6-8 true leaves (6-9 cm height), the seedlings with the same growth selected and transplanted into pots, and 4 seedlings (four directions) planted in each pot. The plastic basins (about 15 cm height) were placed completely randomly and the positions were changed randomly at random intervals to reduce the influence of edge effect. According to the water requirement of peach seedlings, watered in time to ensure that the soil is moist. After 60 days, the plant height and stem diameter of each seedlings were measured. The soluble sugar content of plants was determined by the anthrone colorimetry method (Xiong 2003).

2.3 Statistical Analysis

Statistical analyses were performed using SPSS 22.0 statistical software. Data were analysed using a one-way analysis of variance with the least significant difference test ($p \leq 0.05$).

3 RESULTS

3.1 Plant Height

The difference of plant height after rape, rice and wheat straw treatment reached a significant level (Fig. 1). The plant height of the seedlings treated with rape straw was the highest, 27.09 cm, which increased by 20.51% ($p < 0.05$) compared with the control. The plant height of peach seedlings treated with rice and wheat straw was lower than that of the control, which decreased by 31.14% ($p < 0.05$) and 43.86% ($p < 0.05$), respectively. The order of plant height was ranked as rape straw > control > maize straw > rice straw > wheat straw.

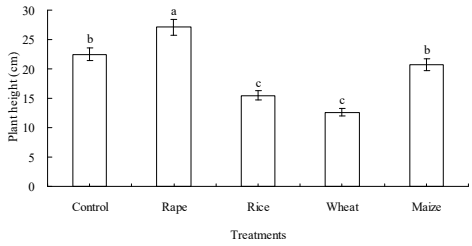

Figure 1: Plant height. Different lowercase letters indicate significant differences based on one-way analysis of variance and the least significant difference test ($p \leq 0.05$).

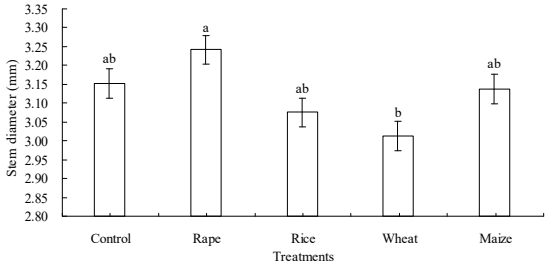

Figure 2: Stem diameter. Different lowercase letters indicate significant differences based on one-way analysis of variance and the least significant difference test ($p \leq 0.05$).

3.2 Stem Diameter

For stem diameter of peach seedlings, the order was ranked as rape straw > control > maize straw > rice straw > wheat straw (Fig. 2). Compared with the control, the rape straw increased the stem diameter of peach seedlings by 2.86% ($p > 0.05$), and the rice straw, wheat straw, and maize straw decreased the stem diameter by 2.43% ($p > 0.05$), 4.42% ($p < 0.05$), and 0.45% ($p > 0.05$), respectively.

3.3 Soluble Sugar Content

There was a great difference in the soluble sugar content of peach seedlings in different treatments (Table 1). Compared with the control, the soluble sugar contents in roots, stems, and leaves of peach seedlings reached a significant level after wheat straw treatment. The order of soluble sugar content in roots was wheat straw > rice straw > maize straw > control > rape straw, soluble sugar content in stems was rape straw > maize straw > control > rice straw > wheat straw, and soluble sugar content in leaves was wheat straw > maize straw > rice straw > control > rape straw. The root and leaf soluble sugar contents of peach seedlings treated with wheat were the highest, which were 78.14 mg/g and 97.74 mg/g, respectively. The soluble sugar content in leaves of peach seedlings in the rape straw treatment was 49.08 mg/g, which was 10.92% ($p < 0.05$) higher than that in the control. There were no significant differences in soluble sugar content between maize straw treatment and control.

Table 1 Soluble sugar content

Treatments	Roots (mg/g)	Stems (mg/g)	Leaves (mg/g)
Control	60.42±1.94c	44.25±1.26b	94.11±0.92b
Rape	58.88±1.43c	49.08±1.67a	93.12±0.75b
Rice	64.50±2.56b	37.93±0.24c	95.59±2.27ab
Wheat	78.14±2.16a	37.91±1.39c	97.74±1.60a
Maize	61.90±1.17bc	43.94± 1.11b	95.12±1.16ab

Different lowercase letters within a column indicate significant differences based on one-way analysis of variance and the least significant difference test ($p \leq 0.05$).

4 DISCUSSIONS

Straw plays an important role in the protection of ecological homes and agricultural environment, and the necessity of straw utilization is of great value to the ecological civilization construction advocated by China (Wang 2020). When rice straw is applied to wheat crops, it is found that the use of rice straw can improve the utilization efficiency of potassium fertilizer and thus increase the yield (Luo 2019). According to near-infrared spectroscopy analysis, rice straw contains abundant soluble proteins (Zhao 2017). In this experiment, the effect of rice straw on plant height and stem diameter of peach seedlings was shown to decrease. Different from the previous research results, the preliminary conclusion was that

rice straw had no promoting effect on the growth of plant height and stem diameter of peach seedlings. Soluble sugar is an important product of plant photosynthesis, and its content reflects the intensity of photosynthesis (Gu 2016). Compared with the control, the soluble protein content of peach seedlings treated with rice straw did not change significantly, indicated that the photosynthesis of peach seedlings did not increase under the action of rice straw. Studies have shown that rape straw returning to the field can increase the aboveground biomass of maize and improve the nitrogen absorption of roots (Fu 2016). In this experiment, rape straw treatment significantly increased the plant height and stem diameter of peach seedlings which was consistent with previous experiments. In this experiment, through the processing of rape straw, peach seedling soluble sugar content in the stem of no significant differences compared with controls, but in the stem, soluble sugar content was significantly higher than control, preliminary inference, after the rape straw processing peach seedling can promote the storage of soluble sugar in the stem. Maize straw is also widely used in production, but its effect is not as good as that of wheat straw and rice straw. In the study of Yue et al. (Gong 2015), it shows that the application of maize straw in production could increase soil water content, but the decrease of soil temperature would lead to the yield reduction of spring maize. However, using maize straw in summer maize planting can increase the yield (Zhang 2014). In this experiment, compared with control, no significant increase of maize straw application on plant height, stem diameter and the content of soluble sugar of peach seedlings. Studies have found that wheat straw returning to the field can promote the growth of maize seedlings, including increasing the stem diameter and leaf width (Jiang 2014). Mulching with wheat straw on the soil surface can improve the yield and quality of pakchoi and tomato (An 2012). In this experiment, compared with the control, the plant height and stem diameter of peach seedlings were significantly decreased after wheat straw treatment, which was inconsistent with previous studies. Compared with the control, the soluble sugar content in stems of seedlings was significantly decreased after wheat straw treatment, but the soluble sugar content in the roots and leaves of the seedlings was significantly higher than that of the control.

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