Effects of different time of buckle shed on superoxide dismutase and peroxidase activities of grape leaves

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Abstract. The effects of buckled shed of different time on the superoxide dismutase (SOD) and peroxidase (POD) activities of grape leaves (tender, function and old leaves) were studied by without buckle shed (CK), buckled shed on January 1st, 2018 (I) and buckled shed on January 20th, 2018 (II), sampled 6 times with interval one week. The results showed that the SOD and POD activities of grape tender leaves and functional leaves under buckled shed on January 1st and buckled shed on January 20th treatments were increased to varying degrees. However, the activities of SOD and POD of grape old leaves under buckled shed on January 1st and buckled shed on January 20th treatments increased in the early stage and decreased in the later stage. The SOD activities of old leaves sampled for the sixth time were higher 17.17% and 12.00% than those of the two treatments, respectively. The POD activity in old leaves in the sixth sampling of treatment buckled shed on January 1st decreased 11.00%. The results showed that the activities of SOD and POD in tender leaves, functional leaves and early old leaves of grapes were increased by the treatment of buckled shed, which indicated that the treatment of buckled shed could promote the growth of grapes and enhance resistance, and there was no significant difference between the buckled shed on January 1st and buckled shed on January 20th treatments.

1. Introduction

Peroxidase (POD) is an enzyme that is highly active and widely present in plants. Its activity is constantly changing during plant growth and development. In general, the plant tissue has weak activity in young parts and high activity in aged tissues. Plants contain a large number of peroxisomes, which are closely related to photosynthesis, oxidative oxidation, and respiration. Superoxide dismutase (SOD) is widely distributed in various organisms and is an important antioxidant enzyme in organisms. It can fight and block the damage caused by free radicals, and repair damaged cells in time. Its level in the body directly indicates aging and death [1-2]. Grape plays an important role in fruit tree production in China. In recent years, the cultivated area has increased rapidly [3]. The level of grape production depends largely on the soil climatic conditions and the level of cultivation techniques. Large plastic covered shed cultivation is an important development direction of grape cultivation in recent years. Large plastic covered shed can create microclimate and ecological environment conditions suitable for grape growth, such as light, temperature, water, air, soil and so on. It can defend against adverse external environmental conditions that are not suitable for grape growth, and make grapes mature...
earlier, so as to obtain better economic benefits [4-5]. Large plastic covered shed changes the microclimate and ecological environment conditions for grape survival, which will change the antioxidant enzymes activities and other substances in grapes, thus affecting the growth of grapes. For example, the activity of POD and SOD in two-year-old *Atractylodes lanceolata* in large plastic covered shed was higher than that in two-year-old *Atractylodes lanceolata* outside large plastic covered shed, which promoted its growth [2]. Therefore, in this experiment, after the rain-proof cultivation, the grape was treated with different time and different degrees of buckle shed to study the influence of the enzyme activity on the grape leaves, in order to provide scientific basis for the scientific production of buckle shed grapes.

2. Materials and methods

2.1. Materials
The experimental materials were 'early summer seedless grape' of three-year-old early summer from the grape planting base of Sichuan Guoyi Agricultural Science and Technology Co., Ltd. in Malin Village, Gongyi Town, Pengshan District, Sichuan Province. The base grape density is 150 plants per mu, and the yield per mu is 1500-2000 kg.

2.2. Experimental Design
The experiment was conducted in Chengdu Campus of Sichuan Agricultural University and the grape planting base of Sichuan Guoyi Agricultural Science and Technology from January to August 2018. There are three treatments in this experiment, which are uncovered shed (CK), buckled shed on January 1st, 2018 (I) and buckled shed on January 20th, 2018 (II). The cultivation and management of grapes are managed according to the standardized cultivation of grapes in local facilities. After treatment, grapes were sampled one month before ripening, beginning on May 20, 2018, and ending on June 30, 2018, samples were collected six times, once a week on average. The activities of superoxide dismutase (SOD) and peroxidase (POD) in grape leaves were determined by NBT photoreduction and guaiacol colorimetry respectively [6].

2.3. Statistical Analyses
Statistical analyses were performed using SPSS 20.0 statistical software. Data were analyzed with one-way analysis of variance with least significant difference at the 5% significance level.

3. Results and Discussion

3.1. SOD activity of grape tender leaves
Compared with the control, the SOD activity of the tender leaves of the two treatments (buckled shed on January 1st, 2018 and buckled shed on January 20th, 2018) increased in the six sampling times (Figure 1). Compared with the control, the SOD activity of the first sample increased 25.51% ($P < 0.05$) and 27.00% ($P < 0.05$), the second sample increased 23.28% ($P < 0.05$) and 22.00% ($P < 0.05$), the third sample increased 21.50% ($P < 0.05$) and 20.00% ($P < 0.05$), the fourth sample increased 20.09% ($P < 0.05$) and 21.00% ($P < 0.05$), the fifth sample increased 24.73% ($P < 0.05$) and 23.00% ($P < 0.05$) and the sixth sample increased 42.83% ($P < 0.05$) and 44.00% ($P < 0.05$), respectively. There was no significant difference in the activity of tender leaves enzymes between the two treatments.

3.2. SOD activity of grape functional leaves
Compared with the control, the SOD activity of grape functional leaves of the two treatments (buckled shed on January 1st and buckled shed on January 20th) increased in the six sampling times (Figure 2). The change trend of enzyme activity in functional leaves was basically the same as that in tender leaves. In the first sampling, the two treatments (buckled shed on January 1st, 2018 and buckled shed
on January 20th, 2018) were improved 107.45% ($P < 0.05$) and 110.00% ($P < 0.05$) respectively compared with the control. However, there was no significant difference in SOD activity between the two treatments (buckled shed on January 1st, 2018 and buckled shed on January 20th, 2018) after five sampling and the control. However, it can be seen that the SOD activities of grape functional leaves increased between the two treatments (buckled shed on January 1st, 2018 and buckled shed on January 20th, 2018) after six sampling and the control.

3.3. SOD activity of grape old leaves

The changes of enzyme activities in old leaves sampled six times were not consistent (Figure 3). Compared with the control, there was no significant difference in the SOD activities of the old leaves from the first, third and fourth sampling of the two treatments. Compared with the control, the SOD activities of old leaves in the second sampling of the two treatments were increased 1.66% ($P < 0.05$) and 7.00% ($P < 0.05$) respectively. The SOD activities of old leaves sampled for the fifth and sixth time reached the maximum under the control treatment. The SOD activities of old leaves sampled for the fifth time were higher 13.56% ($P < 0.05$) and 6.00% ($P < 0.05$) than those of the two treatments, respectively. The SOD activities of old leaves sampled for the sixth time were higher 17.17% ($P < 0.05$) and 12.00% ($P < 0.05$) than those of the two treatments, respectively.

3.4. POD activity of grape tender leaves

In the three treatments, the change trend of POD activity of tender leaves sampled six times was the same, showing that the enzyme activity of tender leaves increased (Figure 4). And compared with the control, each treatment has reached a significant difference. Compared with the control, the POD activity of grape tender leaves of the first sample increased 10.00% ($P < 0.05$) and 11.00% ($P < 0.05$), the second sample increased 10.00% ($P < 0.05$) and 11.00% ($P < 0.05$), the third sample increased 15.00% ($P < 0.05$) and 14.00% ($P < 0.05$), the fourth sample increased 13.00% ($P < 0.05$) and 13.00% ($P < 0.05$), the fifth sample increased 13.00% ($P < 0.05$) and 14.00% ($P < 0.05$) and the sixth sample increased 8.00% ($P < 0.05$) and 8.00% ($P < 0.05$), respectively.
3.5. **POD activity of grape tender leaves**

The POD activity of functional leaves was similar to that of tender leaves. The POD activity of functional leaves of the two treatments was higher than that of the control, and the difference was significant (Figure 5). Compared with the control, the POD activity of grape tender leaves of the first sample increased 12.00% ($P < 0.05$) and 10.00% ($P < 0.05$), the second sample increased 20.00% ($P < 0.05$) and 21.00% ($P < 0.05$), the third sample increased 11.00% ($P < 0.05$) and 10.00% ($P < 0.05$), the fourth sample increased 20.00% ($P < 0.05$) and 21.00% ($P < 0.05$), the fifth sample increased 22.00% ($P < 0.05$) and 20.00% ($P < 0.05$) and the sixth sample increased 23.00% ($P < 0.05$) and 21.00% ($P < 0.05$), respectively.

Figure 5. POD activity of grape functional leaves.

3.6. **POD activity of grape old leaves**

There was no significant difference in enzyme activity between the two treatments in the first to fifth sampling of old leaves and the control treatment (Figure 6). Compared with the control, the activity of the old leaves enzymes in the sixth sampling of treatment buckled shed on January 1st decreased significantly, but there was no significant difference in the activity of the old leaf enzymes in the sixth sampling of treatment buckled shed on January 20th. Compared with the control, the activity of senescent enzymes in the sixth sampling of treatment buckled shed on January 1st decreased 11.00% ($P < 0.05$).

Figure 6. POD activity of grape old leaves.

4. **Conclusions**

The experiment showed that the SOD and POD activities of six grape tender leaves and functional leaves under buckled shed on January 1st and buckled shed on January 20th treatments were increased to varying degrees. However, the activities of SOD and POD of old grape leaves under buckled shed on January 1st and buckled shed on January 20th treatments increased in the early stage and decreased in the later stage. The SOD activities of old leaves sampled for the sixth time were higher 17.17% and 12.00% than those of the two treatments, respectively. The POD activity in old leaves in the sixth sampling of treatment buckled shed on January 1st decreased 11.00%. The results showed that the activities of SOD and POD in tender leaves, functional leaves and early old leaves of grapes were increased by the treatment of buckled shed, which indicated that the treatment of buckled shed could promote the growth of grapes and enhance resistance, and there was no significant difference between the buckled shed on January 1st and buckled shed on January 20th treatments.

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