Effects of different buckle shed time on catalase activity and malondialdehyde content in grape leaves

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Abstract. The effects of different buckle shed time on catalase (CAT) activity and malondialdehyde (MDA) content in grape leaves (tender, function and old leaves) were studied involving the following: without buckle shed (CK), buckle shed on January 1st, 2018 (BS I), buckle shed on January 20th, 2018 (BS II), sampled 6 times with interval one week. The result showed that buckle shed increased the CAT activity of grape tender and function leaves, the grape tender leaves of BS I and BS II at the sampling date 4 had the highest and increased by 32.36% and 39.14% respectively, but the grape function leaves of BS I and BS II at the sampling date 2 had the highest and increased by 25.46% and 26.53% respectively. The buckle shed had no significant effect on CAT activity of grape old leaves in early sampled date. The different buckle shed time had no significant effect on CAT activity of grape leaves. Buckle shed increased the MDA content in grape tender leaves, the grape tender leaves of BS I and BS II at the sampling date 4 had the highest and increased by 204.0% and 202.7% respectively. Buckle shed decreased the MDA content in grape function leaves, the grape function leaves of BS I and BS II at the sampling date 2 had the lowest and increased by 46.39% and 48.19% respectively. The MDA content of grape old leaves in the early sampled was decreased compared with control, but in the later sampled increased.

1. Introduction
Grape (Vitis vinifera L.) is a woody vines of the vine grape family vitis, and it is one of the oldest fruit tree species in the world. Grape yield and cultivation area in China are among the largest grape countries in the world, and fresh grapes rank first in the world. Buckle shed is a common way of warming and humidifying in grape protected cultivation, the prevention and control management of temperature and humidity, fat water, flowers and fruits, diseases and insect pests can be strengthened after buckle shed. The timely buckle shed of grape can effectively reduce the temperature difference between day and night, prolong the life span of grape leaves, thus promote the growth and development of fruit, make the fruit in a relatively favorable position in the nutritional competition, promote the growth of fruit and improve the quality of fruit [1]. Catalase (CAT) is one of the antioxidant enzymes that are widely present in animal and plant [2]. In plants, CAT mainly removal of H2O2 produced by the process of mitochondria electron transport, β-fatty acid oxidation and photorespiration, to prevent the damage caused by reactive oxygen species (ROS) free radicals to plants [3]. CAT and superoxide dismutase (SOD), peroxidase (POD), ascorbic acid enzyme (APX) are called antioxidant enzyme protection system [4]. The research.
in recent years has shown that CAT plays an important role in plant growth and development, stress defense response, oxidative senescence and other physiological processes [5]. Malondialdehyde (MDA) is one of the products of membrane lipid peroxide, and its production can also aggravate the damage of membrane. The quantity of malondialdehyde (MDA) can represent the degree of membrane lipid peroxide, and it can also indirectly reflect the antioxidant capacity of plant tissue [6]. The MDA content is a common index in the study of senescence physiology and resistance physiology of plants. In view of this, the effects of different shedding shed time (without buckle shed was used as control) on CAT activity and MDA content in grape leaves were studied in this experiment.

2. Materials and methods

2.1 Materials
The materials in this experiment are three-year-old 'Early summer seedless' grape in Grape planting base of Sichuan guoyi agricultural technology limited company, which is located in Maling Village, Gongyi Town, Pengshan District, Sichuan Province, it belongs to the subtropical humid climate of Sichuan Basin, mild and rainy, and has four distinct seasons. The grape density was 150 plants per acre, and the acre yield was 1500 ~ 2000 kg.

2.2 Methods
The experiment was carried out at the grape base in January 2018. Some grapes were selected for buckle shed on January 1st, 2018 (BS I), some other grapes were selected for buckle shed on January 20th, 2018 (BS II), The treatment without buckle shed was used as control (CK), a total of 3 treatments. Daily management, daily fertilizer management according to standardized cultivation of grape in local facilities. One month before maturity (May 20, 2018), the tender leaves, functional leaves and old leaves of grape were sampled once a week at intervals of 7 days, each treatment was repeated 6 times for sampled a total of 6 times.

3. Determination items and methods
The catalase (CAT) activity and the malondialdehyde (MDA) content in leaves of different parts of grape were determined every 7 days. Determination of CAT activity by potassium permanganate titration [7], determination of MDA content by thiobarbituric acid colorimetric method [7].

4. Statistical analyses
Analysis of variance with Excel 2013 and SPSS 20.0 software.

5. Results

5.1 Effect of different buckle shed time on CAT activity of grape leaves

5.1.1 CAT activity of grape tender leaves. The CAT activity of grape tender leaves of BS I and BS II were both higher than that of CK (Fig. 1). The CAT activity of BS I at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 20.49% ($P < 0.05$), 8.09% ($P < 0.05$), 32.36% ($P < 0.05$), 38.39% ($P < 0.05$), 9.52% ($P < 0.05$) and 22.72% ($P < 0.05$) compared with CK. The CAT activity of BS II at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 20.49% ($P < 0.05$), 21.96% ($P < 0.05$), 9.38% ($P < 0.05$), 39.14% ($P < 0.05$), 6.80% ($P > 0.05$) and 23.72% ($P < 0.05$) compared with CK. There had no significant difference in BS I and BS II ($P > 0.05$).

5.1.2 CAT activity of grape function leaves. The CAT activity of grape function leaves of BS I and BS II were both higher than that of CK (Fig. 2). The CAT activity of BS I at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 15.13% ($P < 0.05$), 25.46% ($P < 0.05$), 6.95% ($P < 0.05$), 17.71% ($P < 0.05$), 19.93% ($P < 0.05$) and 18.57% ($P < 0.05$) compared with CK. The CAT activity of BS II at
the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 14.67% \((P < 0.05)\), 26.53% \((P < 0.05)\), 8.71% \((P < 0.05)\), 20.88% \((P < 0.05)\), 15.90% \((P < 0.05)\) and 19.94% \((P < 0.05)\) compared with CK. There had no significant effect on CAT activity of grape function leaves of buckle shed time.

5.1.3 CAT activity of grape old leaves. There had no significant effect on CAT activity of grape old leaves of buckle shed time at the sampling date 1, 2, 3 and 4 (Fig. 3). At the sampling date 5, the CAT activity of grape old leaves of BS I and BS II were both lower than that of CK, the BS I and BS II were respectively decreased by 15.60% \((P < 0.05)\) and 5.02% \((P > 0.05)\) compared with CK, but the BS II was increased by 12.53% \((P > 0.05)\) compared with BS I. At the sampling date 6, the CAT activity of grape old leaves of BS I and BS II were both lower than that of CK, and ranked as CK > BS II > BS I, the BS I and BS II were respectively decreased by 16.06% \((P < 0.05)\) and 4.70% \((P < 0.05)\) compared with CK, but the BS II was increased by 13.53 \((P < 0.05)\) compared with BS I.

5.2 Effect of different buckle shed time on MDA content in grape leaves

5.2.1 MDA content in grape tender leaves. The MDA content in grape tender leaves of BS I and BS II were both higher than that of CK (Fig. 4). The MDA content in BS I at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 18.37% \((P < 0.05)\), 25.23% \((P < 0.05)\), 36.05% \((P < 0.05)\), 204.0% \((P < 0.05)\), 47.55% \((P < 0.05)\) and 87.34% \((P < 0.05)\) compared with CK. The MDA content in BS II at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 19.73% \((P < 0.05)\), 24.30% \((P < 0.05)\), 47.55% \((P < 0.05)\) and 87.34% \((P < 0.05)\) compared with CK. There had no significant difference in BS I and BS II \((P > 0.05)\).
5.2.2 MDA content in grape function leaves. The MDA content in grape function leaves of BS I and BS II were both lower than that of CK (Fig. 5). The MDA content in BS I at the sampling date 1, 2, 3, 4, 5 and 6 were respectively decreased by 25.94% ($P<0.05$), 46.39% ($P<0.05$), 42.20% ($P<0.05$), 27.42% ($P<0.05$), 25.25% ($P<0.05$) and 25.18% ($P<0.05$) compared with CK. The MDA content in BS II at the sampling date 1, 2, 3, 4, 5 and 6 were respectively increased by 25.47% ($P<0.05$), 48.19% ($P<0.05$), 39.45% ($P<0.05$), 26.37% ($P<0.05$), 28.23% ($P<0.05$) and 27.36% ($P<0.05$) compared with CK. There had no significant effect on MDA content in grape function leaves of buckle shed time.

5.2.3 MDA content in grape function leaves. The MDA content in grape old leaves of BS I and BS II were both lower than that of CK at sampling date 1, 2 and 3 (Fig. 6), the MDA content in BS I and BS II at the sampling date 1 were respectively decreased by 11.74% ($P<0.05$) and 11.30% ($P<0.05$) compared with CK, at the sampling date 2 were respectively decreased by 34.58% ($P<0.05$) and 31.78% ($P<0.05$) compared with CK, at the sampling date 3 were respectively decreased by 60.00% ($P<0.05$) and 58.50% ($P<0.05$) compared with CK, but there had no significant effect on MDA content in grape old leaves of buckle shed time at sampling date 1, 2 and 3. There had no significant differences in BS I and BS II at sampling date 4 ($P>0.05$). the MDA content in grape old leaves of BS I and BS II at sampling date 5 and 6 were both higher than that of CK, and ranked as BS I > BS II > CK.

![Figure 5. MDA content in grape function leaves](image1)

![Figure 6. MDA content in grape old leaves](image2)

6. Conclusion

In this study, the CAT activity of the grape tender and function leaves were improved after buckle shed, but there is no significant difference between the time of the buckle shed. Buckle shed was not significantly affected in the early sampled of the CAT activity of grape old leaves, but in the later sampled was lower than that of the control. The MDA content in grape tender leaves was increased compared with the control after buckle shed, but the MDA content in function leaves was significantly lower than that of the control. The MDA content of grape old leaves in the early sampled was lower than that of the control, but in the later sampled was significantly higher than that of the control.

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