

The Study of KNO_3 Breaks the Dormancy of *Ziziphus jujube* 'Mizao' and Its Influence on Antioxidant Substances

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Abstract. In this experiment, *Ziziphus jujube* 'Mizao' was used as the test material, and potassium nitrate which is of different concentrations (3%, 6%, 9%) was used to conduct the breaking dormancy test in the dormancy phase. The treatment with clear water was used as a control to explore the effect of potassium nitrate to break dormancy and changes in antioxidants during dormancy. The results showed that 6% potassium nitrate can activate the antioxidant system during the forced dormancy of jujube (January 30 th to February 14 th). The pharmacy of this concentration is better than other concentration treatment to break the forced dormancy of the jujube bud. 9% potassium nitrate is basically ineffective or even inhibitory to break the forced dormancy. Combined with the analysis of fruit in the later period, the experiment concluded that 6% potassium nitrate was the most effective pharmacy concentration to break the dormancy of *Ziziphus jujube* 'Mizao'.

Introduction

The *Ziziphus jujube* 'Mizao' is a *ziziphus* plant of *rhamnaceae* which originated from the middle and lower reaches of the Yellow River [1]. It has more than 3000 years of cultivation history [2]. China holds more than 98% of the world's jujube trees and nearly 100% of international trade in jujube products [3]. The dormancy of fruit trees is a very complicated phenomenon, and the inner dormancy, also known as natural dormancy, is a phenomenon and a necessary phase for the suspension of growth of most temperate deciduous fruit trees during their growth and development [4]. Most perennial plants sleep over cold winters with deciduous tree trunks, tree buds, tubers, scaly grass, rhizomes, etc. Potassium nitrate is also used in breaking dormancy of the fruit tree buds and has a good effect. D S Gao [5]. found that potassium nitrate acts to break peach dormancy. And studies have shown that KNO_3 affects dormancy by regulating H_2O_2 activity in the mid-dormancy of deciduous fruit tree buds. Y Y Hou [6] studied that potassium nitrate at concentrations of 5% and 7% had the best effect of breaking the dormancy of apples.

Materials and Methods

Materials. The experiment was conducted at the Sichuan Agricultural University from 2017 to 2018. The 7-year-old *Ziziphus jujube* 'Mizao' trees are used as test materials which were from Yonglian Village, Yongxin Town, Santai County, Mianyang City. The spraying time was set at 3 levels on November 7, 2017 (trees had fallen), November 28, 2017, and January 30, 2018. The chemical agent potassium nitrate (KNO_3) application concentration was set at 4 levels, respectively 0 (clear water, control), 3%, 6%, 9%. The single plant was 1 cell, 3 replicates, completely random. The second day after the spraying, sampling was started. Each sample was taken from each plot to collect two branches on the jujube of the head, and the samples were taken once a week. The samples were brought back to the laboratory with a sampling box, and stored in a -10°C refrigerator for use.

Methods. The determination of SOD was performed using the nitrogen blue tetrazolium (NBT) method [7]. The determination of POD was performed using guaiacol method [7]. The determination of O_2^- activity is based on the method of Bi Lei [8]. The determination of MDA activity is based on the method of Bi Lei [8].

Results and Discussion

Change in SOD activity. SOD is an important enzyme in the plant's in vivo antioxidant system. As shown (Fig 1), the treatment with the breaking agent (KNO_3) has greatly enhanced the activity of SOD, and the SOD activity has shown a trend of “gradually increasing”. The increase in SOD activity helps clear free radicals accumulated by the tree under low temperature stress and breaks the forced dormancy. On the 15th day, the activity of SOD in the twigs treated with 6% potassium nitrate was the highest, indicating that the treatment had stronger ability to activate the antioxidant system.

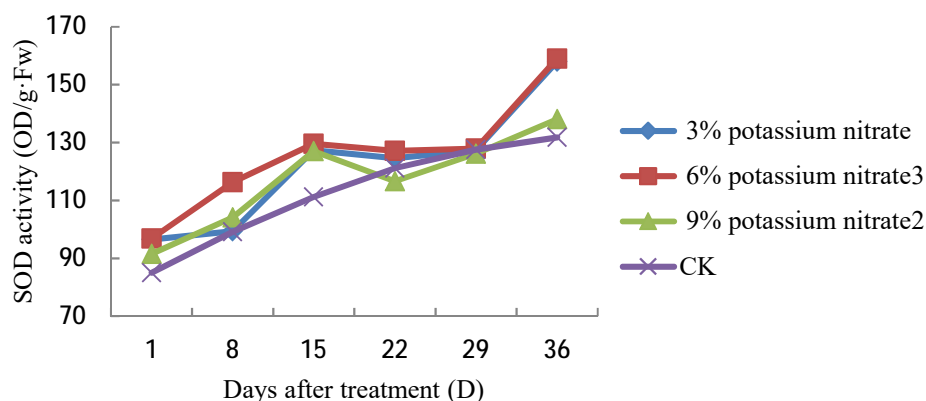


Fig 1 Change of SOD activity

Change in POD activity. Like SOD, POD is also an enzyme in vivo of plants that protects plants against the damage of reactive oxygen. As shown in Figure 2, the activity of POD in the *Ziziphus jujube* ‘Mizao’ buds first decreases and then rises. After the application of the breaking agent (KNO_3), the activity of POD in the entire forced dormant period was always higher than that of the control. After 15 days of treatment, the POD activity gradually increased, which may be related to the germination of the *Ziziphus jujube* ‘Mizao’ buds. When the POD activity was at the bottom, the forced dormancy was mean to be relieved. 6% potassium nitrate had the fastest change in POD activity, which was significantly higher than other concentrations of the same agent.

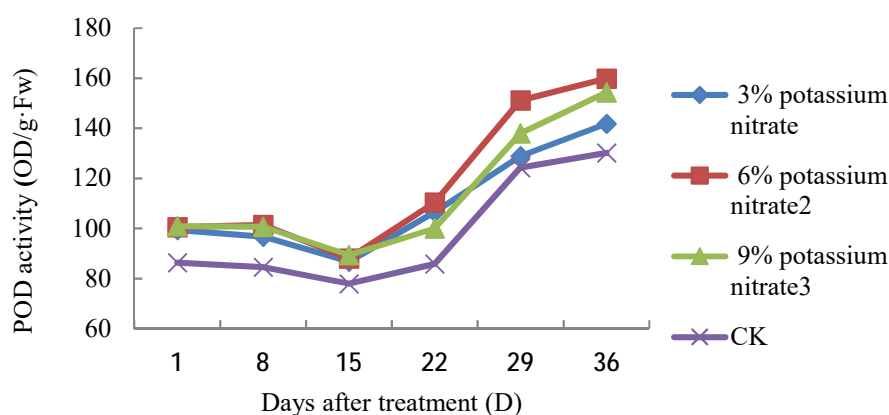
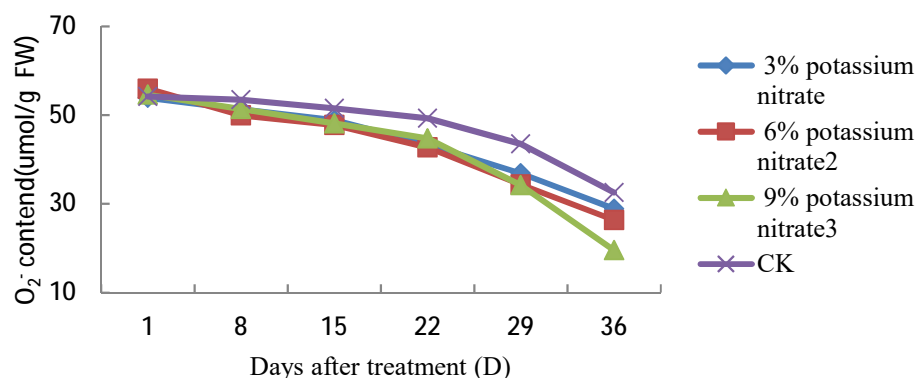


Fig 2 Change of POD activity

Change in O_2^- contend. The contend of O_2^- of *Ziziphus jujube* ‘Mizao’ buds treated with different concentrations of breaking agents (KNO_3) was significantly lower than that of the control. The trend of “gradual decline” (Fig 3) is opposite to the change in SOD activity.

Fig 3 Change of O_2^- content

Change in MDA content. Change in permeability of the membrane is one of the dormant phenomena, and MDA is the final breakdown product of membrane lipid peroxidation. Its content can reflect the degree of lipid peroxidation. After analysis of the data, the MDA content showed a trend of “change first and then change smoothly” (Fig 4).

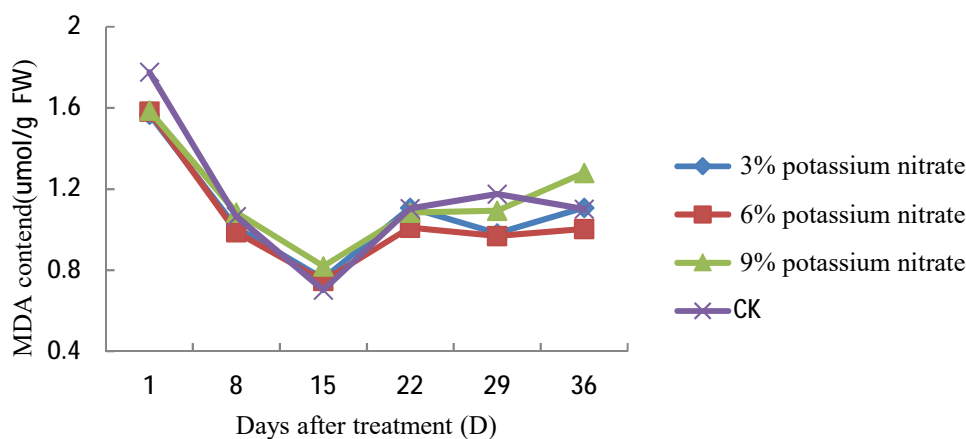


Fig 4 Change of MDA content

Conclusions

Deciduous fruit tree dormancy divided into related dormancy, internal dormancy and forced dormancy [9]. Forced dormancy is a phenomenon which is caused by the satisfaction of internal factors such as coldness, but environmental stress (such as water stress, nutrient deficit, etc.) make it cannot bud. In this study, it was found that SOD activity was low in the early stage of forced dormancy. With the change of the outside temperature, the SOD activity gradually increased and the POD activity gradually decreased. After the forced dormancy was released, the POD activity gradually increased when the *Ziziphus jujube* ‘Mizao’ branches were ready to sprout. SOD is the first enzyme in the degradation of superoxide radicals, and its rise can be seen as an adaptive response to cold stress. The higher the SOD activity, the stronger the decomposing effect of participating in the low temperature, the content of O_2^- will gradually decrease, the activity of POD will decrease rapidly when the forced dormancy begins, and the POD activity will gradually increase after the dormancy is released. This is related to F.H Pang and J.J Du [10] found consistent results in the study of changes in enzyme activity of antioxidant enzymes in buds during apricot dormancy. The results of this experiment showed that 6% potassium nitrate had the strongest ability to activate the enzyme activity of the antioxidant system during the dormant dormancy of *Ziziphus jujube* ‘Mizao’ buds.

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