

Effect of "Zaofengling" on Fruit Retention and Quality of *Zizyphus Jujuba* 'Zhanshanmizao'

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Abstract: To study the effects of "Zaofengling" on the fruit retention and quality of *Zizyphus Jujuba* 'Zhanshanmizao', the experiment measured the fruit drop rate and quality of *Z. Jujuba* 'Zhanshanmizao' by using different concentrations of "Zaofengling". The results showed that "Zaofengling" could reduce the fruit drop rate of *Z. Jujuba* 'Zhanshanmizao', with the best effect of 40 mg/L. "Zaofengling" had little effect on the fruit fresh weight and longitudinal and transverse diameter, but these were slightly increased with 40 mg/L. "Zaofengling" reduced the content of soluble sugar and titratable acid, it had little effect on vitaminC content but this was a little increased with 40 mg/L on August 29 th. So, spraying 40 mg/L "Zaofengling" is more effective for reducing the fruit drop rate of *Z. Jujuba* 'Zhanshanmizao' and increasing the fruit fresh weight and volume, but it slightly reduces the content of soluble sugar and titratable acid.

Introduction

Zizyphus Jujuba 'Zhanshanmizao' is a plant belongs to *Rhamnaceae*.R.Br. Its taste is sweet, tender, crisp, and has high nutritional value. It is widely welcomed by consumers [1]. *Z. Jujuba* 'Zhanshanmizao' is the same as other jujube varieties has a severe fruit drop phenomenon [2]. The researches have shown that the main cause of dropping fruit is that jujube has large amount of flowers, long flowering period and consumes too much nutrients [3]. "Zaofengling" is a growth regulator with gibberellin and 6-Benzylaminopurine as the main ingredient, which has retention of flowers and fruits by promoting cellular growth and inhibiting the formation of flower pedicle and fruit pedicle [4]. The studies in recent years have shown that "Zaofengling" can improve the fruit set rate of *Zanthoxylum piperitum f. inermis makino* [5]. Gibberellin can keep high content of soluble solid and titratable acid of Yali pear and improve effect of storage [6]. Titratable acid content in Wink grape is enhanced, and longitudinal diameter is obviously increased after spraying gibberellin [7]. Spraying 3.6% benzylaminopurine-gibberellic acid(mixture) and 75% crystal powder of gibberellic acid(single) can improve the fruit set rate, yield, coloring and quality of Kyoho grape [8]. As a result, the experiment studied the fruit drop phenomenon, trends of fruit growth and development and change of the fruit inclusion by spraying different concentrations of "Zaofengling" at full flowering stage of *Z. Jujuba* 'Zhanshanmizao'. It can provide scientific bases for improving fruit set rate, yield and quality of *Z. Jujuba* 'Zhanshanmizao'.

Materials and Methods

Materials. The test material base is located in rice jujube in Zhanshan Experimental Park, Yonglian Village, Yongxin Town, Santai County, Mianyang. The soil on the test site was loam, and the soil and fertilizer conditions were consistent and well managed. The experimental material is *Z. Jujuba* 'Zhanshanmizao' that is six years old.

Experimental Design. The experiment started at full flowering stage of *Z. Jujuba* 'Zhanshanmizao'(from 25% to 75% of jujube flowers) on May 17 th, 2017. Concentrations of "Zaofengling" were set to: 10 mg/L, 20 mg/L, 30 mg/L, 40 mg/L, with clear water as contrast (CK). "Zaofengling" with different concentrations was sprayed sunny day before 9 a.m or lower temperatures after 5 p.m.

Spray "Zaofengling" until it dropped and contrast was sprayed water. Each of the three trees was a block group. Repeat 3 times for each treatment of 9 trees.

Before spraying, each tree was randomly selected from four branches in the south, east, north and west directions were numeral listed. The number of flowers on the listed tree was counted (100 or more). After spraying "Zaofengling", the number of storage flower and fruit set in the branches was surveyed every 14-15 days from June 18 th, and fruit drop rate of each treatment was calculated. Fruit drop rate = [total number of flower - (the number of storage flower + the number of fruit set)]/ total number of flower * 100%. Fruit was taken on the upper part of the fruiting branches (shedding shoot of jujube) of each treated and listed branch group every 14-15 days, which was used in the experiment. The fresh fruit weight was measured by weighing method and fruit longitudinal and transverse diameter was measured by vernier caliper. The soluble sugar content was determined by anthrone colorimetry, titratable acid content was determined by acid base neutralization titration and vitamin C content was determined by 2,6-dichlorophenol phenol titration [9].

Results and Analysis

Effect of Fruit Drop with Different Concentrations. Under natural conditions(CK), the drop fruit rate of *Z. Jujuba* 'Zhanshanmizao' is rapidly increasing from June 18th to July 2 th (Fig. 1), although it increases since then, the rate of increase is much lower than the early stage. 10 mg/L, 20 mg/L and 30 mg/L "Zaofengling" can reduce drop fruit rate during early development of fruit. However, the drop fruit rate is lower than CK after spraying 40 mg/L "Zaofengling" during development of fruit. Therefore, 40 mg/L "Zaofengling" is effective for easing the fruit drop phenomenon of *Z. Jujuba* 'Zhanshanmizao'.

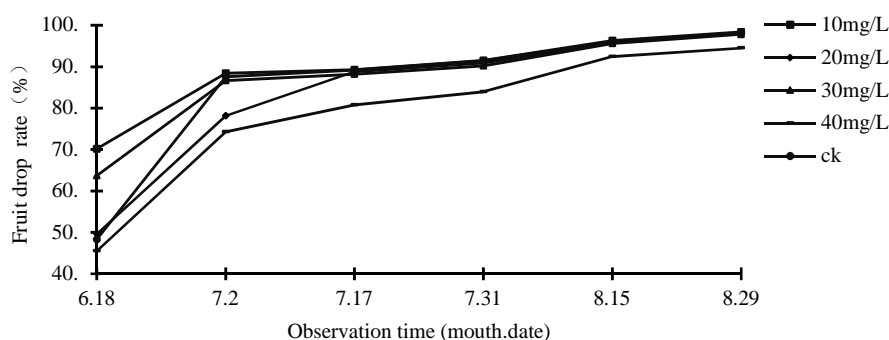


Fig. 1 Effect of fruit drop rate of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Effect of Fruit Fresh Weight with Different Concentrations. Under natural conditions(CK), the fruit fresh weight of *Z. Jujuba* 'Zhanshanmizao' is rapidly increasing from June 18 th to July 2 th (Fig. 2), although it increases since then, the rate of increase is much lower than the early stage. It reaches the maximum of 3.97g on August 29 th. The fruit fresh weight increases obviously during late development of fruit(July 31 th – August 29 th) after spraying 40 mg/L "Zaofengling". The fruit fresh weight is more 5.89% than CK on August 29 th. Therefore, 40 mg/L "Zaofengling" can improve fruit fresh weight of *Z. Jujuba* 'Zhanshanmizao'.

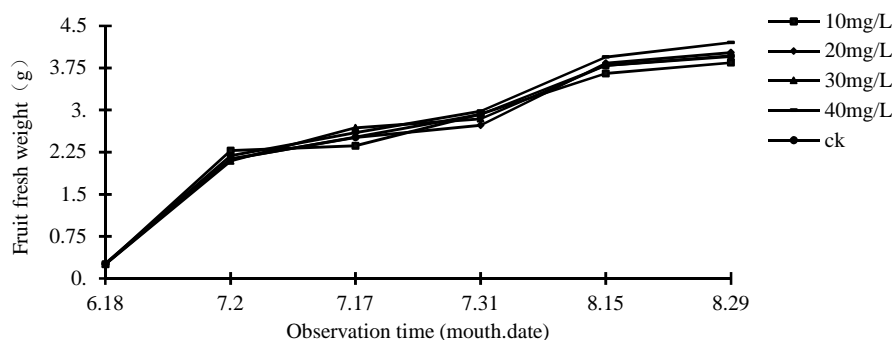


Fig. 2 Effect of fruit fresh weight of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Effect of Fruit Longitudinal and Transverse Diameter with Different Concentrations. Under natural conditions(CK) , the fruit longitudinal and transverse diameter of *Z. Jujuba* 'Zhanshanmizao' is rapidly increasing from June 18 th to July 17 th (Fig. 3, Fig. 4), then it increases slightly. The fruit transverse diameter is more than CK during development of fruit after spraying 40mg/L "Zaofengling". The fruit longitudinal diameter is more than CK from July 17 th to August 29 th after spraying 40 mg/L "Zaofengling". It is more 4.3% than CK at August 29 th. Therefore, 40 mg/L "Zaofengling" can increase the fruit longitudinal and transverse diameter of *Z. Jujuba* 'Zhanshanmizao'.

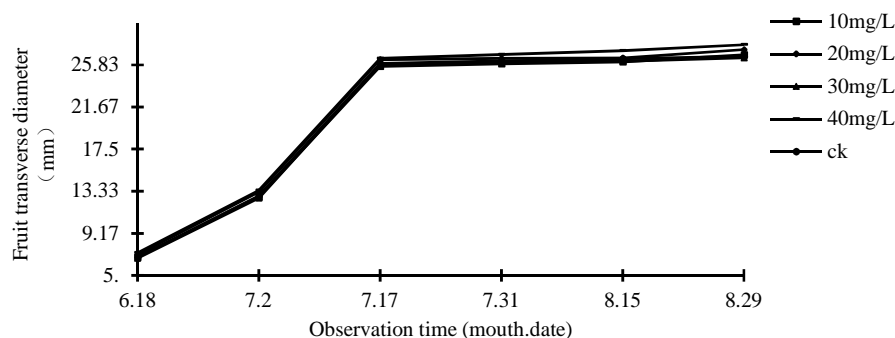


Fig. 3 Effect of fruit transverse diameter of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

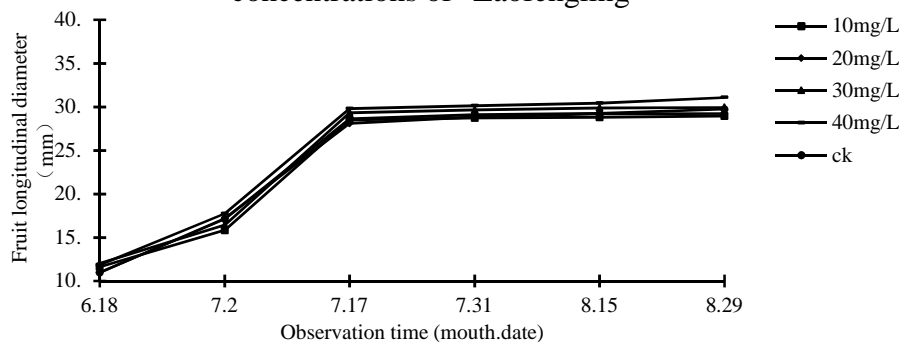


Fig. 4 Effect of fruit longitudinal diameter of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Effect of Fruit Soluble Sugar Content with Different Concentrations. Under natural conditions(CK) , the fruit soluble sugar content of *Z. Jujuba* 'Zhanshanmizao' is rapidly increasing from June 18 th to July 17 th (Fig. 5), then it reduces slightly and gradually increases. The fruit soluble sugar is less than CK during development of fruit after spraying "Zaofengling" except for 20 mg/L "Zaofengling" on July 17 th. Therefore, "Zaofengling" can reduce the fruit soluble sugar content of *Z. Jujuba* 'Zhanshanmizao'.

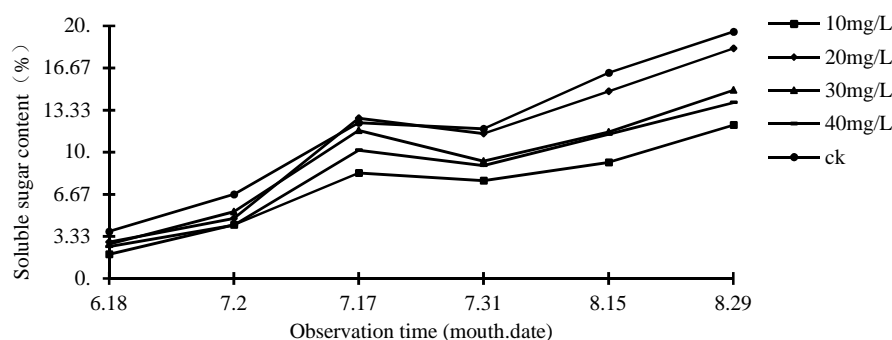


Fig. 5 Effect of fruit soluble sugar content of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Effect of Fruit titratable acid Content with Different Concentrations. Under natural conditions(CK), the fruit titratable acid content of *Z. Jujuba* 'Zhanshanmizao' is high at the beginning, reduces rapidly from June 18 th to July 2 th. Although it reduces since then, the rate of reduction is much lower than the early stage (Fig. 6). Fruit titratable acid content is more than CK during early development of fruit after spraying 20 mg/L, 40 mg/L "Zaofengling" and is more 13.6% than CK with 20 mg/L "Zaofengling" on June 18 th. Fruit titratable acid content is less than CK from July 31 th to August 29 th after spraying 40 mg/L "Zaofengling". It is less 32.0% than CK at August 15 th. Therefore, "Zaofengling" has a large effect on the fruit titratable acid content during early and late development of fruit, and it reduces obviously the fruit titratable acid content during late development of fruit.

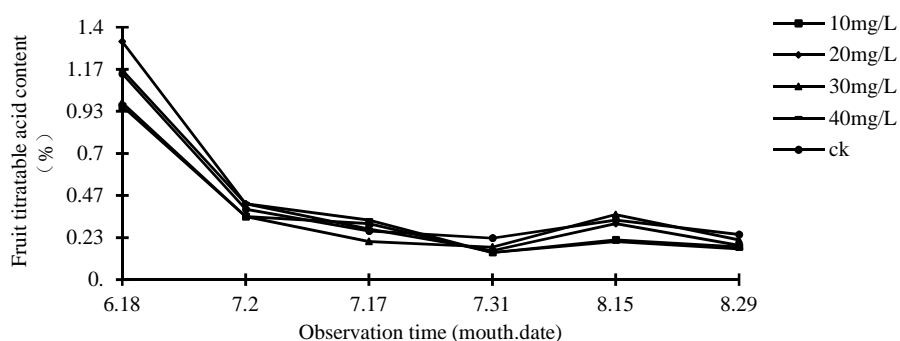


Fig. 6 Effect of fruit titratable acid content of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Effect of Fruit VitaminC Content with Different Concentrations. Under natural conditions(CK), fruit vitaminC content of *Z. Jujuba* 'Zhanshanmizao' is gradually increasing from June 18 th to July 17 th (Fig. 7), gradually reduces from July 17 th to July 31 th, increases and gradually reduces. The VitaminC content is more 14.1% than CK on July 17 th and increases little after spraying 40 mg/L "Zaofengling". Therefore, "Zaofengling" has little effect on the VitaminC content of *Z. Jujuba* 'Zhanshanmizao', but increases the VitaminC content during late development of fruit after spraying 40 mg/L "Zaofengling".

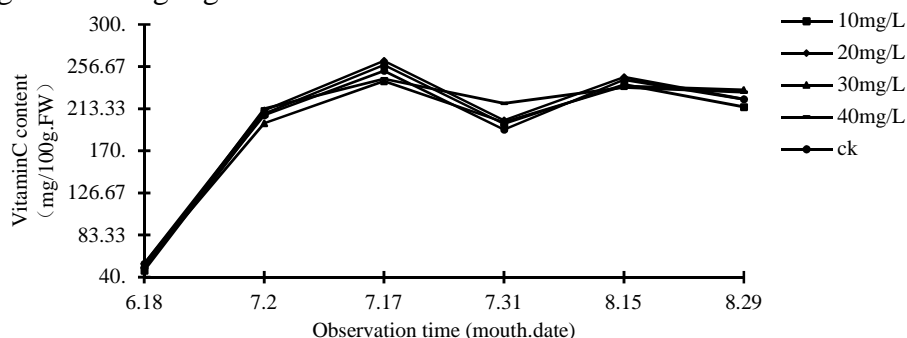


Fig. 7 Effect of fruit vitaminC content of *Z. Jujuba* 'Zhanshanmizao' with different concentrations of "Zaofengling"

Conclusions

"Zaofengling" can effectively reduce fruit drop rate of *Z. Jujuba* 'Zhanshanmizao' with the best effect of 40 mg/L. At the same time, 40 mg/L "Zaofengling" can little increase fresh weight and longitudinal and transverse diameter. The content of soluble sugar and titratable acid is obviously reduced after spraying "Zaofengling". However, 40 mg/L "Zaofengling" can little increase the content of vitaminC. Therefore, 40mg/L "Zaofengling" is more effective for easing the fruit drop phenomenon of *Z. Jujuba* 'Zhanshanmizao' and improve fruit quality and size. But *Z. Jujuba* 'Zhanshanmizao' becomes less flavorful for "Zaofengling" reducing the content of soluble sugar and titratable acid.

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