Effects of Selenium Fertilizer on Fruit Quality and Plant Resistance of Blueberry

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Abstract. To investigate the effect of exogenous selenium on the fruit quality and plant resistance of blueberry, field experiment was conducted. The fruit qualities, including single fruit weight, soluble solids, soluble sugar content, horizontal and longitudinal diameter were examine. Additionally, the plant resistance index, such as chlorophyll content, MDA content and SOD activity in leaves were measured. The results showed that high concentrations of selenium inhibited the increase of blueberry fruit weight. Selenium at a concentration of 100 $mg \cdot L^{-1}$ promoted the production of soluble solids, while that of 150 $mg \cdot L^{-1}$ inhibited their production. That of 50 $mg \cdot L^{-1}$ promoted the growth of fruit, and that of 20 $mg \cdot L^{-1}$ was more beneficial to horizontal growth than longitudinal growth. The treatment of 150 $mg \cdot L^{-1}$ was most beneficial to the production of chlorophyll total content. Applying selenium fertilizer improved the plant's resistance to superoxide anion radical damage, but it was ineffective to resist the damage of membrane lipid oxidation.

1. Introduction

Blueberry (*Vaccinium* spp.) is the new fruit species which has high economic value and broad prospects for development [1-5]. Selenium (Se) is a widely distributed but relatively rare chemical element in nature. Plants can absorb selenium from soil and air through roots and leaves, and also emit selenium into the air through the leaves [6]. The appropriate amount of selenium also helps to increase crop growth potential, improve stress resistance, photosynthesis, and antagonism of heavy metals [7]. Studies on pears, peaches, dates, strawberries, peanut sprouts and rice have shown that selenium has effects on plants [8-11]. This experiment used the south highland variety 'O'Neal', which is performed well in southern China, and sprayed different concentrations of selenium fertilizer on the leaves. The physiological indicators and fruit quality of blueberries were measured to analyze the effects of selenium fertilizer on blueberry growth and fruit quality.

2. Materials and methods

2.1. Materials

Three-year old plants of south highbush variety 'O'Neal' were used. The plants were grown in Qionglai City, Sichuan province.

2.2. Experiment design

In this experiment, the selenium fertilizer used was Na_2SeO_3, and the fertilizing method was leaf foliar spraying. The test was conducted with clear water as the control, and the concentration was treated as 20, 50, 100, 150 mg·L^{-1}, with 3 replicates per treatment. Fertilizer solution spraying starts from the beginning of the leaf opening period of blueberry and sprays once every two weeks for a total of 4 sprayings. The fertilizer solution is sprayed with foliar spray, avoiding rainy days and noon time, spraying evenly on the front and back of the leaves of the whole plant until dropped.

3. Results

3.1. Effects of selenium fertilizer on blueberry fruit quality

Blueberries without selenium spraying indicated the largest single fruit weight (figure. 1). The blueberry fruit weight of 50 mg·L^{-1} selenium was slightly lighter than the control. Blueberries with a concentration of 100 mg·L^{-1} and 150 mg·L^{-1} showed the lowest single fruit weight.

The soluble solid content of blueberry with the concentration of 100 mg·L^{-1} was the highest (figure. 2), followed by the spraying concentration of 50 mg·L$^{-1.}$ The soluble solids content in blueberry with the concentration of 150 mg·L^{-1} selenium was the lowest.

The content of soluble sugar in blueberry was the lowest when spraying 100 mg·L^{-1} selenium (figure. 2). The soluble sugar content of blueberry with a concentration of 20 mg·L^{-1} and 150 mg·L^{-1} was higher than that of the control.

The horizontal and longitudinal diameter of blueberry with the concentration of 50 mg·L^{-1} selenium were the largest and larger than those of the control, and the others were lower than the control (figure. 3). For the fruit shape index, the blueberry sprayed with selenium concentration of 20 mg·L^{-1} was the largest and larger than the control (figure. 4).

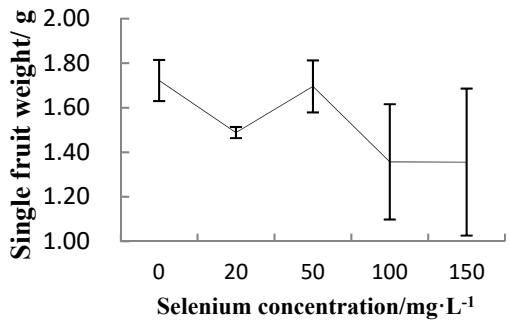

Figure. 1 Effects of selenium fertilizer on blueberry Single fruit weight

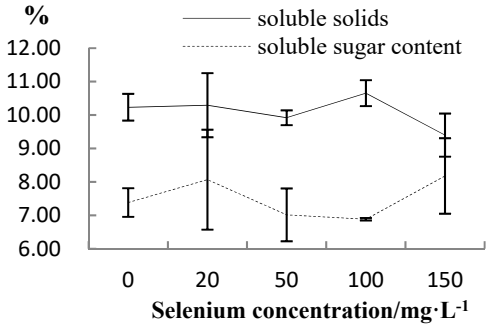

Figure. 2 Effects of selenium fertilizer on blueberry soluble solids and soluble sugar content

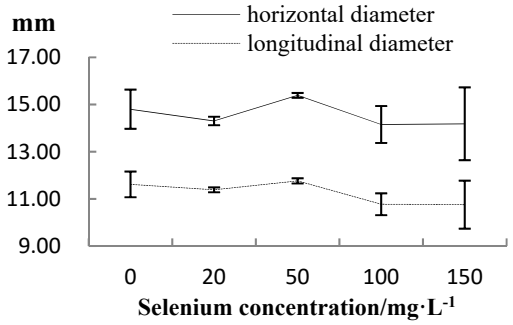

Figure. 3 Effects of selenium fertilizer on blueberry horizontal diameter and longitudinal diameter

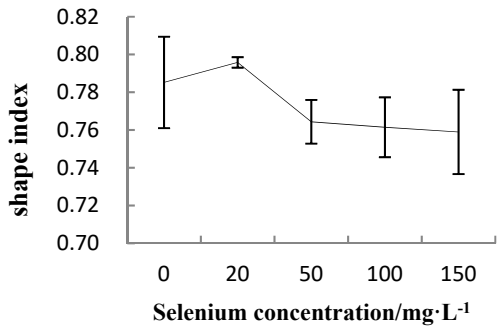

Figure. 4 Effects of selenium fertilizer on blueberry shape index

3.2. Effects of selenium fertilizer on blueberry chlorophyll content

The total content of chlorophyll in blueberry with the concentration of 150mg·L^{-1} was the highest, and the total content of chlorophyll in blueberry with the concentration of 50mg·L^{-1} was the lowest and lower than the control (figure. 5). The chlorophyll A content of blueberry was the highest when the concentration of selenium was 150 mg·L^{-1}. The chlorophyll B content of blueberry with the concentration of 20mg·L^{-1} was the highest, and the content of chlorophyll B of blueberry without spraying selenium was the lowest.

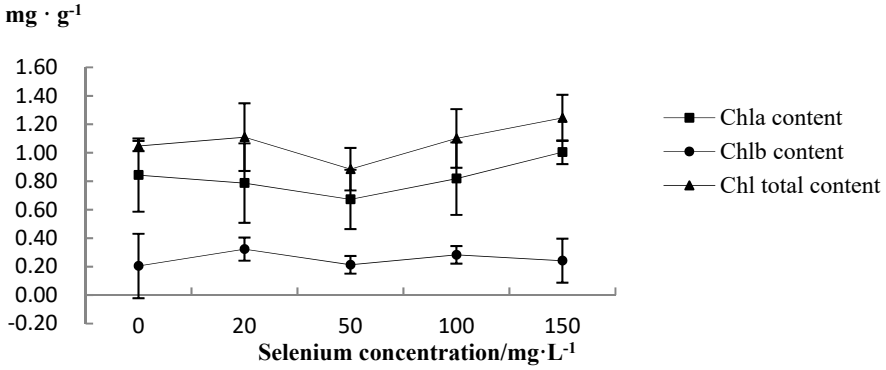

Figure. 5 Effects of selenium fertilizer on blueberry chlorophyll content

3.3. Effects of selenium fertilizer on the plant resistance of blueberry

The content of MDA in blueberry was the highest when the concentration of selenium was 100 mg·L^{-1}, and the content of MDA was the lowest when the concentration of selenium was 20 mg·L^{-1} (figure. 6). The SOD activity of blueberry with the concentration of 50 mg·L^{-1} selenium was the highest, and that of blueberry with the concentration of 20 mg·L^{-1} selenium was the lowest (figure. 7).

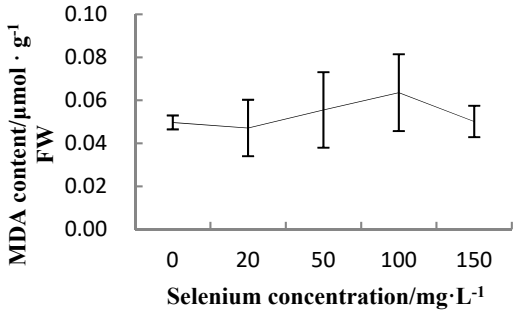

Figure. 6 Effects of selenium fertilizer on blueberry MDA content

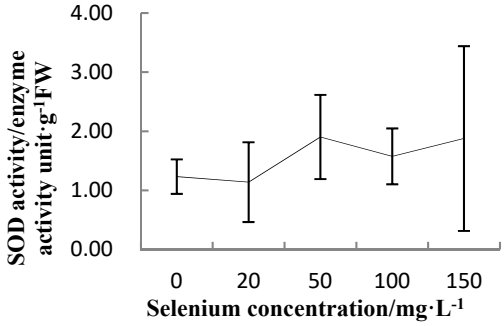

Figure. 7 Effects of selenium fertilizer on blueberry SOD activity

4. Conclusion

From the results, different selenium concentrations exhibited different effects on fruit quality and plant resistance of blueberry. High concentrations of selenium inhibited the increase of blueberry fruit weight. Studies have shown that the appropriate concentration of selenium can significantly increase the soluble solids content of fruit trees [12]. Selenium at a concentration of 100 mg·L^{-1} promoted the production of soluble solids in blueberries, while selenium at a concentration of 150 mg·L^{-1} inhibited their production. Selenium at a concentration of 50 mg·L^{-1} promoted the growth of fruit in the horizontal and longitudinal diameter. Selenium at a concentration of 20 mg·L^{-1} was more beneficial to horizontal growth than longitudinal growth. Low concentration of selenium increased fruit shape index, high concentration of selenium reduced fruit shape index. The treatment of 150 mg·L^{-1} was beneficial to the production of chlorophyll A. Selenium treatment was all beneficial to the production

of chlorophyll B, and that of 20 mg·L^{-1} was the best. The treatment of 150 mg·L^{-1} was most beneficial to the production of chlorophyll total content. Applying selenium fertilizer could improve the plant's resistance to superoxide anion radical damage, but it was ineffective to resist the damage of membrane lipid oxidation. The treatment at a concentration of 20 mg·L^{-1} was a little beneficial to blueberry defense against membrane lipid oxidation damage to cells. The treatment of 50 and 150 mg·L^{-1} was most beneficial to blueberry defense against superoxide anion radical damage to cells.

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