Study on Selenium Accumulation Characteristics of Different Tomato Varieties

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Keywords: Tomato; Growth; Selenium accumulation

Abstract: A pot experiment was conducted to study the effects of soil application of selenium on the growth and selenium accumulation of different tomato varieties. The results showed that there were differences in the biomass, selenium content and selenium accumulation amount of tomato varieties. The biomass, selenium content and selenium accumulation amount of roots, stems and leaves of yellow cherry tomato reached the maximum, Fruit biomass of large tomatoes was the largest, followed by the yellow cherry tomatoes, the highest selenium content was red cherry tomatoes, followed by yellow cherry tomatoes, and the highest selenium accumulation amount was big tomatoes, followed by the yellow cherry tomatoes. In summary, selenium accumulation ability of yellow cherry tomatoes is strong, and its growth is the best.

1. Introduction

Selenium is one of the essential micronutrients for the human body. It can effectively prevent the production of cancer and tumors, increase the body's immunity, and prevent human aging [1-4]. The lack of selenium is significantly associated with many diseases for human, such as Keshan disease of residents in some areas of China. The main reason is that the intake of selenium by residents is insufficient [5]. Due to the lack of selenium induced diseases, it is possible to play a preventive role by supplementing selenium. Some diseases are significantly improved after selenium supplementation [6]. The content of selenium in the human body depends on the amount of selenium in people's foods, the amount of selenium in foods depends on selenium content in the soil and the accumulation ability of the crop to selenium, due to the selenium content is extremely unevenly distributed on the surface of the earth, and selenium deficiency is particularly serious in some areas (China's severely depleted selenium area accounts for about 30% of the country's land area) [7]. Therefore, understanding the selenium accumulation ability of crops has certain practical significance for human selenium supplementation. Tomato is a common fruit vegetable. It is not only nutritious but also convenient to eat. It has dual edible use of fruits and vegetables and is widely grown in the world [8]. To develop selenium accumulation tomatoes for daily diet, which can satisfy the human body's to demand for common nutrients and achieve the goal of selenium supplementation for selenium-deficient people. So, this study used five tomato varieties as materials to study the selenium accumulation characteristics of them by applying 5 mg/kg of selenium to the soil, in order to screen out the tomato varieties with good selenium accumulation ability.

2. Materials and Methods

Materials. The experiments were conducted at Sichuan Agricultural University (30° 42′ N, 103° 51′ E), Wenjiang, China. The soil was taken from farmland around Sichuan Agricultural University (Chengdu campus) and was sandy loam soil. Its basic physical and chemical properties were pH 6.29, organic matter 21.16 g/kg, total nitrogen 1.09 g/kg, total phosphorus 1.2 g/kg, total potassium 22 g/kg, available phosphorus 16.22 mg/kg and available potassium 156.2 mg/kg. After retrieving it,

spread it flat and dry it for one week, screened it with 1 cm sieve, and set aside.

Five varieties were used, including Y20-1 (Red cherry tomatoes), Small Tomato-4-1 (Yellow cherry tomatoes), Cafan-13-1 (Purple cherry tomatoes), Y6-1 (Green cherry tomatoes), stone´ s-14-1 (large tomatoes). Tomato seeds are provided by the fruit and vegetable research institute of Chengdu campus of Sichuan agricultural university. $Na_2O_3Se{\cdot}5H_2O$ is purchased from Chengdu kelong chemical reagent factory. All chemicals used in experiments were of analytical grade.

Experimental Design. The experiment was conducted in Sichuan Agricultural University (Chengdu Campus) from April to July 2017. In April 2017, Air-drying the soil, sieving with a 5 mm sieve, and weighing 10.0 kg in a plastic pot of 22 cm × 29 cm (height × diameter) respectively. $Na_2O_3Se{\cdot}5H_2O$ solution was added to the soil and the Se concentration was 5 mg/kg. The soil was kept moist, kept for 40 d, and mixed with soil from time to time. In May 2017, five varieties of tomatoes (red cherry tomatoes, yellow cherry tomatoes, green cherry tomatoes, purple cherry tomatoes, and large tomatoes) of the same size were selected and transplanted into pots, two plants were planted in each pot, and each treatment was repeated 3 times. After the ripening of the tomato fruit, the dry weight and selenium content of the root, stem, leaf, and fruit were measured.

Statistics Analyses. Statistical analysis was carried out by using SPSS 20.0 statistical software. The data were analyzed by one-way ANOVA, with the least significant difference at the 5% confidence level.

3. Results and Analysis

Biomass of Tomatoes. As can be seen from Table 1, there is a certain difference between the biomass of different organs of different tomato varieties. The biomass of roots ranged from 1.48g to 1.94 g, the biomass of stems ranged from 14.65g to 21.99 g, the biomass of leaf range from 4.98g to 10.29 g, and the biomass of fruit range from 0.31g to 1.05 g. Among them, the biomass of root, stem and leaf of yellow cherry tomato were significantly higher than other varieties. The order of the size is: yellow cherry tomato> red cherry tomato> purple cherry tomato> large tomato> green cherry tomato. The biomass of fruit is the large tomato. The order of the size is: large tomato> yellow cherry tomato> red cherry tomato> purple cherry tomato> green cherry tomato, the order of the root/shoot ratio is green cherry tomato> large tomato> purple cherry tomato> yellow cherry tomato > Red cherry tomatoes. It indicated that the yellow cherry tomatoes grew best under the condition of 5mg/kg selenium.

Table 1 Biomass of tomatoes

Variety	Roots (g/plant DW)	Stems (g/plant DW)	Leaves (g/plant DW)	Root/Shoot ratio	Fruits (g/plant DW)
Red	1.59±0.21bc	17.42±0.83b	9.78±1.20b	0.06	0.46±0.03c
Yellow	1.94±0.10a	21.99±0.82a	10.29±0.18a	0.06	0.56±0.04b
Purple	1.67±0.15b	16.03±0.39bc	8.69±0.34bc	0.07	0.44±0.04c
Green	1.48±0.05c	14.65±0.15c	4.98±0.33d	0.08	0.31±0.04d
Large	1.63±0.33bc	14.97±2.09bc	7.33±0.60c	0.07	1.05±0.03a

Values are means ± standard errors. The data followed by different lowercase indicate significant difference of 5% level.

Selenium Content in Tomatoes. It can be seen from Table 2, the effect of applying external selenium to soil on the selenium content of different tomato varieties is different. The selenium content in roots, stems and leaves of yellow cherry tomatoes was higher than other varieties. The selenium content in roots, stems, and leaves of yellow cherry tomatoes compared with the green cherry tomato with the lowest selenium content increased by 283.83%, 103.74%, and 58.24%,

respectively, the order of the size is: yellow cherry tomato> red cherry tomato> purple cherry tomato> large tomato> green cherry tomato. The content of selenium in fruits was the highest in red cherry tomatoes, followed by yellow cherry tomatoes, and the order of selenium content in each organ of five different tomato varieties was root>leaf>stalk>fruit.

Table 2 Selenium Content in Tomatoes

Variety	Roots (μg/g)	Stems (μg/g)	Leaves (μg/g)	Fruits (μg/g)
Red	112.54±0.92b	31.68±0.49b	44.01±0.56a	28.46±0.57a
Yellow	141.44±1.29a	34.86±0.56a	46.08±0.72a	26.95±0.58a
Purple	74.87±0.56c	23.43±0.48c	43.68±0.45a	20.25±0.36b
Green	36.85±0.43e	17.11±0.32d	29.12±0.38b	13.87±0.24c
Large	60.20±0.56d	22.61±0.41c	32.15±0.49b	15.39±0.47c

Values are means ± standard errors. The data followed by different lowercase indicate significant difference of 5% level.

Selenium Accumulation Amount of Tomatoes. From Table 3, it can be seen that the selenium accumulation amount of different varieties of tomato is different at the same selenium level. The accumulation amount of selenium in roots, stems, and leaves of yellow cherry tomatoes reached the maximum. Compared with red cherry tomatoes, purple cherry tomatoes, green cherry tomatoes, and big tomatoes, the yellow cherry tomato roots increased by 53.34%, 119.55%, 403.10% and 179.65%, respectively, the stems increased by 38.90%, 104.10%, 205.92%, and 126.48%, respectively, and the leaves increased by 10.22%, 24.98%, 227.12%, and 101.30% respectively, the order of the size is: yellow cherry tomato> red cherry tomato> purple cherry tomato> large tomato> green cherry tomato. The accumulation amount of selenium in the fruits of the large tomato was the highest, compared with the green cherry tomato with the lowest selenium accumulation, the selenium accumulation amount in the large tomato fruit increased by 275.81%. The order of the selenium content was as follows: large tomato> yellow cherry tomato> red cherry tomato> purple cherry tomato> green cherry tomato.

Table 3 Selenium accumulation amount of tomatoes

Variety	Roots (μg/plant)	Stems (μg/plant)	Leaves (μg/plant)	Fruits (μg/plant)
Red	178.94±1.58c	551.87±2.36b	430.42±2.08b	13.09±0.54b
Yellow	274.39±1.92a	766.57±4.24a	474.39±2.55a	15.09±0.08a
Purple	124.98±1.33b	375.58±2.27c	379.58±1.86c	8.91±0.42c
Green	54.54±0.87e	250.66±2.18e	145.02±2.76e	4.30±0.47d
Large	98.12±0.91d	338.47±2.35d	235.66±2.63d	16.16±0.43a

Values are means ± standard errors. The data followed by different lowercase indicate significant difference of 5% level.

4. Conclusions

By applying exogenous selenium to the soil, the growth and selenium content of different varieties of tomatoes under the same selenium application conditions were studied. The results showed that there are some differences in biomass, selenium content and accumulation between tomato varieties,

under the concentration of 5mg/kg selenium, the biomass, selenium content and selenium accumulation amount of yellow cherry tomato were higher than those of other varieties, indicating that it had stronger selenium enrichment ability and promoted its growth. It indicates that which has more strong selenium accumulation ability and promotes its growth.

Acknowledgements

This work was financially supported by the Application Infrastructure Project of Science and Technology Department of Sichuan Province (2016JY0258).

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