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Effect of Application Accumulator Plant Straw on the Osmotic Adjustment Substances and Malondialdehyde Content of Lettuce

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Abstract: The effects of accumulator plant straw on the osmotic adjustment substances and malondialdehyde content of lettuce under cadmium stress were studied by pot experiment. The results showed that the content of malondialdehyde in the leaves of lettuce after the application of accumulator plants, including *Siegesbeckia orientalis*, *Conyza canadensis* and *Eclipta prostrata* decreased by 29.26%, 29.74% and 30.55%, the content of soluble sugar increased by 2.13%, 15.00% and 19.15%, and the content of proline increased by 119.42%, 88.11% and 68.31%, respectively. Therefore, the application of *S. orientalis* straw can reduce the malondialdehyde content in lettuce leaves, increase the content of soluble sugar and proline, and enhance the resistance of lettuce.

1. Introduction

Straw returning has a long history in China's agricultural production and is one of the agronomic measures to improve soil fertility. Straw can produce a large amount of nutrients and allelochemicals during the decomposition process, which can affect soil microbial community structure and crop growth and development [1-2]. Straw returning can optimize soil physicochemical properties by improving soil porosity and solute, thereby improving soil water, fertilizer, gas and heat supply capacity and promoting plant growth [3]. Two consecutive years of cotton straw returning to the field, seed cotton yield and lint yield increased by 18.9% and 19.8%, respectively. Wheat straw returned to the field increased peanut yield by 14.2%, so that soybean yield increased by 70%-75% [4-6]. In cadmium-contaminated soil, the application of cadmium hyperaccumulator plants (*Youngia japonica*, *Siegesbeckia orientalis*, *Bidens pilosa* and *Galinsoga parviflora*) increased the biomass, plant height and number of branches of watercress. It indicated that the application of cadmium hyperaccumulator plant straw promoted the growth of watercress [7]. In this experiment, the effects of accumulator of plant straw on the osmotic adjustment substances and malondialdehyde content of lettuce were studied by applicator accumulator of plant *S. orientalis*, *C. canadensis* and *E. prostrata* under cadmium-contaminated conditions, and the application under cadmium stress was investigated. The effect of accumulator plant straw on lettuce resistance.



2. Materials and methods

2.1. Materials.

Lettuce is a common glass lettuce in Sichuan. Shoots of *S. orientalis*, *C. canadensis* and *E. prostrata* were collected from farmland around Sichuan Agricultural University of Chengdu (not contaminated).

2.2. Experimental design.

In June 2015, the soil was passed through a 300-mesh sieve and 20 kg soil was placed in a bucket (30 cm high, 40 cm diameter). Add heavy metal cadmium to the tested soil in the form of $\text{CdCl}_2 \cdot 2.5\text{H}_2\text{O}$ analytical pure solution at a concentration of 10 mg/kg. After keeping it for 30 days, mixed all the contaminated soil thoroughly and fill it with 21 cm×25 cm (21 cm high, 25 cm diameter) pots, 3 kg per pot. After 7 days of lettuce cultivation, mixed with straw. Six grams of straw were applied to each pot. The four experimental applied in the experiment were as follow: the control (no straw applied), straw of *S. orientalis*, straw of *C. canadensis*, straw of *E. prostrate*. The watering is kept moist. After a week of balance, the seedlings with consistent growth and strong lettuce are transplanted to the prepared cadmium-contaminated soil with straw. Four plants were transplanted per pot, and each treatment was 9 pots. After the seedlings are transplanted, they are placed in a plastic greenhouse, and the soil moisture is maintained at about 80%. After 50 days, the lettuce was matured and samples were taken for determination of each index.

2.3. Statistical 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 discussion

3.1. Malondialdehyde content.

After the application of the accumulator plants at the *S. orientalis*, *C. canadensis* and *E. prostrata* straw, there was no significant difference in the content of malondialdehyde in lettuce leaves between different treatments, which was significantly lower than that the control, with a decrease of 29.26% ($p<0.05$), 29.74% ($p<0.05$) and 30.55% ($p<0.05$), respectively (figure. 1). This indicates that under the condition of cadmium stress, the application of accumulator plant straw reduced the malondialdehyde content in lettuce leaves.

3.2. Soluble sugar content.

Compared with the control, application of straw of the three cadmium accumulator plants increased the soluble sugar content of lettuce by 2.13% ($p>0.05$), 15.00% ($p<0.05$) and 19.15% ($p>0.05$), respectively (figure. 2). The amount of soluble sugar increased most in the straw lettuce application in the *E. prostrata*. The results indicated that the content of soluble sugar in lettuce was increased under cadmium stress by application accumulator plant straw.

3.3. Proline content.

The application of accumulator plant *S. orientalis*, *C. canadensis* and *E. prostrata* significantly increased the proline content of lettuce compared with the control, which increased by 119.42% ($p<0.05$), 88.11% ($p<0.05$) and 68.31% ($p<0.05$), respectively (figure. 3). The amount of proline in straw increased most. This indicates that the application of accumulator plant straw increased the proline content of lettuce under cadmium contaminated conditions.

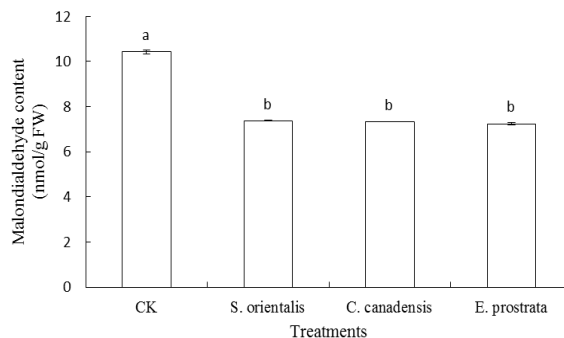


Figure. 1 Malondialdehyde content in lettuce leaves. The lowercase indicates significant difference of 5% level, the same as follow figure.

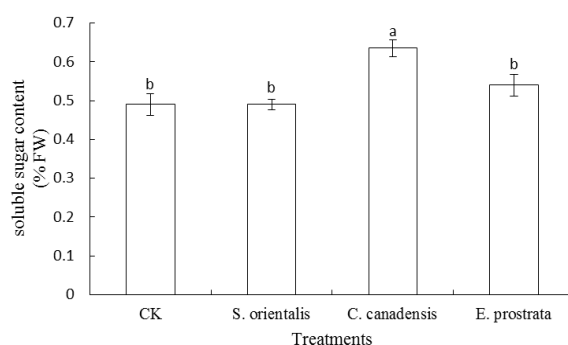


Figure. 2 Soluble sugar content in lettuce leaves.

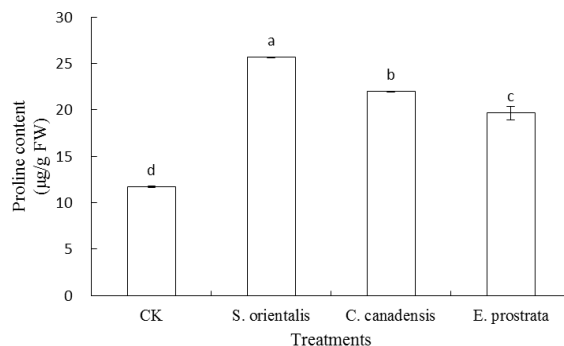


Figure. 3 Proline content in lettuce leaves.

4. Conclusion

The results showed that under the condition of cadmium contaminated, the application of accumulator plant *S. orientalis*, *C. canadensis* and *E. prostrata* reduced the malondialdehyde content of lettuce and increased the content of soluble sugar and proline. This indicates that the application of accumulator plant straw alleviated the oxidative damage of cadmium on lettuce and significantly improved the antioxidant properties of lettuce. Therefore, the ability of plants to resist cadmium stress can be enhanced by accumulator suitable plant straw.

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