IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

Effects of Living *Pterocypsela laciniata* and Its Straw on Soluble Sugar Content in Grape Seedlings under Selenium Stress

To cite this article: Jinpeng Zhu *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **310** 042043

View the article online for updates and enhancements.

This content was downloaded from IP address 180.160.60.121 on 08/10/2019 at 14:35

IOP Conf. Series: Earth and Environmental Science **310** (2019) 042043 doi:10.1088/1755-1315/310/4/042043

Effects of Living *Pterocypsela laciniata* and Its Straw on Soluble Sugar Content in Grape Seedlings under Selenium Stress

Jinpeng Zhu[1], Tengyue Xiao[1], Yingtong Ge[1], Xinyu Huang[1], Yuxi Huang[1] and Lijin Lin[2*]

[1]College of Horticulture, Sichuan Agricultural University, Chengdu, Sichuan, 611130, China

[2]Institute of Pomology and Olericulture, Sichuan Agricultural University, Chengdu, Sichuan, 611130, China

[*]Corresponding author's e-mail: llj800924@qq.com

Abstract. The pot experiment was conducted to study the effects of soluble sugar content of grape seedlings under selenium stress by intercropping and the application of straws in soil. There were five treatments: grape seedlings monoculture; intercropping with *Pterocypsela laciniata* and applying leaf, stem and root straws of *P. laciniata* in soil with grape seedlings, respectively. By analyzing, the results displayed that the soluble sugar content in root and stem was markedly lower than that in leaf and shoot. In five treatments, intercropping was significantly increased the soluble sugar content compared with the control. It promoted the growth and the nutrient substance of *P. laciniata*. On the contrary, applying root, stem and leaf straws of *P. laciniata* in soil reduced the soluble sugar content of grape seedlings. Obviously, applying *P. laciniata* straws could not improve the growth of *P. laciniata*. The content of soluble sugar was always ranked as: grape seedlings intercropping with *P. laciniata* seedlings > grape seedlings monoculture > applying the leaf straw of *P. laciniata* in soil with grape seedlings > applying the stem straw of *P. laciniata* in soil with grape seedlings > applying the root straw of *P. laciniata* in soil with grape seedlings. In a word, intercropping with *P. laciniata* seedling was a best treatment for improving the growth of grape seedlings compared to applying *P. laciniata* straws.

1. Introduction

This experiment was conducted by intercropping and applying *Pterocypsela laciniata* straws in soil to study the change of soluble sugar content. Intercropping is a technology which is better than the sole cropping system and it could provide an increase in productivity per unit area [1]. Intercropping with different hyperaccumulator plant influences the growth of grape seedlings and increased the soluble sugar content compared to the control [2-3]. Straw is an important renewable resource and it has great comprehensive utilization value [4]. The soluble sugar contents in the straw applying treatments were found to be significantly increased and decreased [5]. In addition, applying straws increased the carbohydrate content compared with the control [6].

Pterocypsela laciniata is a perennial herb of *Pterocypsela* and it not only has good flavor, delicate texture and high nutritional value, but also plays an important role in different diseases [7]. Thus, this study selected *P. laciniata* to intercrop with grape seedlings for the effects of soluble sugar content.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

2. Materials and methods

2.1. Materials
During this experimental process, grape seedlings and *P. laciniata* were used as materials to study the effects of soluble sugar content by intercropping and applying *P. laciniata* straw in soil. The seeds of *P. laciniata* were collected from the farmland around Sichuan Agricultural University. In January 2019, the soil was also supposed to prepare and weighed 3 kg air-dried soil putting into each plastic pot which is 15 cm high and 18 cm in diameter, soaking uniformly by 10 mg/kg Se (in the form of Na_2SeO_3) solution for four weeks.

2.2. Methods
In January 2019, the *P. laciniata* seeds were placed in the climate chamber for culture. And at the same time, the cutting seedlings of grape for the experiment were prepared. In February 2019, it was time to select uniform seedlings for intercropping while the fifth true leaves grew from *P. laciniata* seedlings. Three grape seedlings were transplanted into pot for monoculture and two of them intercropped with one *P. laciniata* seedlings. Furthermore, some *P. laciniata* seedlings were collected and divided into three parts of root, stem and leaf. Then, using deionized water to wash them for three times and simmered for 15 min at 110 °C. Finally, dried at 80 °C until constant weight and cut them into small pieces less than 1 cm as different straws. The three parts of *P. laciniata* straws were respectively blended with soil. Each pot contained 6 g *P. laciniata* straws and it meant that every kilogram soil was mixed with 2 g straws of *P. laciniata*. The soil was kept moist and balanced for one week. Then three uniform grape seedlings were transplanted into the soil which contained straw. All in all, this experiment consisted of five treatments: (1) grape seedlings monoculture (MG); (2) grape seedlings intercropping with *P. laciniata* seedlings (PG); (3) applying the leaf straw of *P. laciniata* in soil with grape seedlings (PLG); (4) applying the stem straw of *P. laciniata* in soil with grape seedlings (PSG); (5) applying the root straw of *P. laciniata* in soil with grape seedlings (PRG). Each treatment set up three repetitions and the soil moisture was made 80%. Also, the distance between pots was 15 cm and the position was often exchanged to mitigate marginal effects.

After 60 days, the whole grape seedlings were harvested and divided into three parts of root, stem and leaf. Washed them successively with tap water and deionized water. Then weighed the fresh weight, simmered for 15 min at 110 °C, dried at 80 °C until constant weight and passed through a 100-mesh sieve to analyze soluble sugar content of root, stem, leaf and shoot [8].

3. Results and discussion

3.1. Soluble sugar content in root of grape seedlings
Under selenium stress, the soluble sugar content in roots of grape seedlings was different among treatments. From Figure 1, the content of soluble sugar was the highest while grape seedlings intercropping with *P. laciniata* seedlings and it was 28.10 mg/g in root of grape seedlings which increased by 13.66% compared with grape seedlings monoculture. But for applying *P. laciniata* straws, the soluble sugar content was all lower than intercropping. Compared with grape seedlings monoculture, the content in PLG, PSG and PRG were decreased by 28.37%, 55.41% and 57.74% (Figure 1, $p < 0.05$), respectively. Furthermore, there was no significant difference between PSG and PRG.

3.2. Soluble sugar content in stem of grape seedlings
For the content of soluble sugar in stem, the monoculture and intercropping made higher content than applying *P. laciniata* straws (Figure 2). The soluble sugar content in stem was the same as that in root and it was the highest. Compared with grape seedlings monoculture, the soluble sugar content in PG increased by 10.77% but reduced by 26.32%, 27.26% and 29.89% in PLG, PSG and PRG (Figure 2, *p*

< 0.05), respectively. The treatments which applying leaf, stem and root straw of *P. laciniata* in soil with grape seedlings made the soluble sugar content in stem have no significant difference.

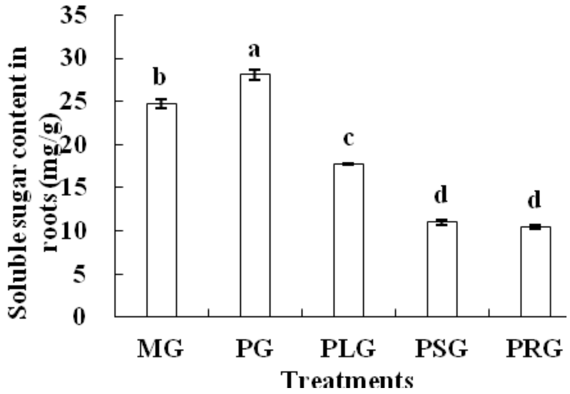

Figure 1. Soluble sugar content in roots of grape seedlings. Different lowercase letters indicated significant differences among treatments at 0.05 levels. MG = grape seedlings monoculture; PG = grape seedlings intercropping with *P. laciniata* seedlings; PLG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PSG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PRG = applying the leaf straw of *P. laciniata* in soil with grape seedlings.

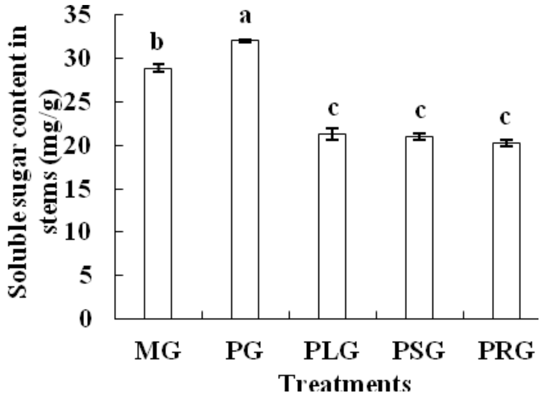

Figure 2. Soluble sugar content in stems of grape seedlings. Different lowercase letters indicated significant differences among treatments at 0.05 levels. MG = grape seedlings monoculture; PG = grape seedlings intercropping with *P. laciniata* seedlings; PLG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PSG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PRG = applying the leaf straw of *P. laciniata* in soil with grape seedlings.

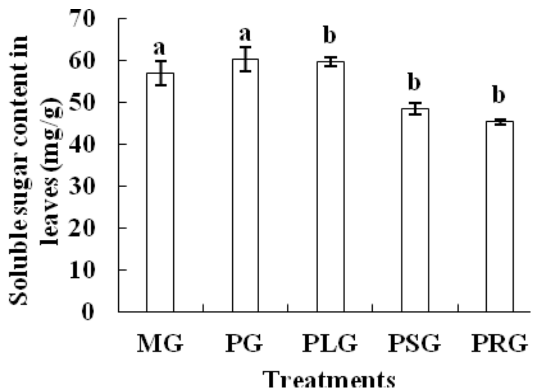

Figure 3. Soluble sugar content in leaf of grape seedlings. Different lowercase letters indicated significant differences among treatments at 0.05 levels. MG = grape seedlings monoculture; PG = grape seedlings intercropping with *P. laciniata* seedling; PLG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PSG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PRG = applying the leaf straw of *P. laciniata* in soil with grape seedlings.

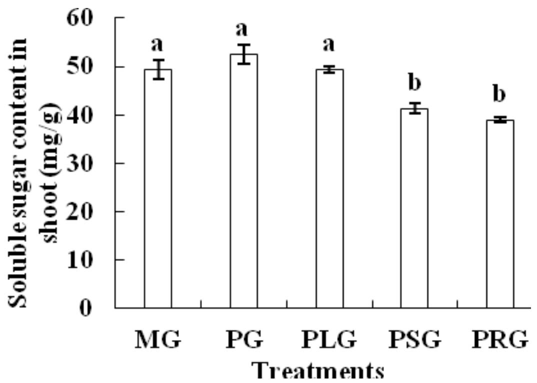

Figure 4. Soluble sugar content in shoot of grape seedlings. Different lowercase letters indicated significant differences among treatments at 0.05 levels. MG = grape seedlings monoculture; PG = grape seedlings intercropping with *P. laciniata* seedling; PLG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PSG = applying the leaf straw of *P. laciniata* in soil with grape seedlings; PRG = applying the leaf straw of *P. laciniata* in soil with grape seedlings.

3.3. Soluble sugar content in leaf of grape seedlings

Compared with soluble sugar content in root and stem, it was higher in leaf. No obvious changes were observed among five treatments and the content was always between 40 and 60 mg/g. When grape seedlings intercropping with *P. laciniata* seedlings, the content of soluble sugar was still the highest compared to other treatments, and the order from high to low was: PG > MG > PLG > PSG > PRG and the content respectively decreased by 6.12%, 6.21%, 21.49% and 25.92% (Figure 3, $p < 0.05$), compared with PG.

3.4. Soluble sugar content in shoot of grape seedlings
Under selenium stress, there were no significant difference among MG, PG and PLG. Grape seedlings monoculture and intercropping with *P. laciniata* seedlings made the soluble sugar content still higher than three treatments of applying *P. laciniata* straw. Compared with grape seedlings monoculture, the soluble sugar content was increased by 6.12% while grape seedlings intercropping with *P. laciniata* seedlings. But decreased by 0.01%, 16.38% and 21.09% (Figure 4, $p < 0.05$) when soil applied root, stem and leaf straw of *P. laciniata*, respectively. The order of content was the same as that in leaf: PG > MG > PLG > PSG > PRG.

4. Conclusions
In this experiment, grape seedlings and *P. laciniata* seedlings were used as materials to explore the effects of soluble sugar content by intercropping *P. laciniata* seedlings and applying *P. laciniata* straws in soil under selenium stress. Among five treatments, the results showed that the soluble sugar content of grape seedlings was the highest by intercropping with *P. laciniata* seedlings and it always ranked as: PG > MG > PLG > PSG > PRG. It meant that the soluble sugar content of grape seedlings was significantly decreased by applying leaf, stem and root straws of *P. laciniata*. On the contrary, intercropping could increase the content. Furthermore, the soluble sugar content in leaf and shoot were higher than that in stem and root.

Acknowledgments
This work was financially supported by the Undergraduate Students Research Interest Training Program of Sichuan Agricultural University (2019299).

References
[1] Liang, K.M., Tao, Y., Zhang, S.B., Zhang, J.E., Luo, M.Z., Fu, L., Zhao, B.L. (2015) Effects of intercropping rice and water spinach on net yields and pest control: an experiment in southern China. Inter. J. Agric. Sustain., 14: 448-465.
[2] Huang, J.J., Lin, L.J., Chen, F.B., Wang, T., Liu, L., Liao, M.A., Ren, W. (2018) Effects of intercropping Bidens L. species on growth and cadmium accumulation of grape seedlings. J. Sichuan. Agric. Univ., 36.
[3] Lin, L.J., Liao, M.A., Lv, X.L., Liang, D., Xia, H., Wang, J., Wang, X. (2017) Addition of straw from hyperaccumulator plants to cadmium-contaminated soil increases cadmium uptake by loquat seedlings. Environ. Mon. Assess., 189: 217.
[4] Shen, Y.Y., Chen, H. (2009) The progress of study on soil improvement research with straw stalk. Chin. Agric. Sci. Bull., 25: 291-294.
[5] Zhao, P., Zhan, G.L., Xu, J.K., Mei, X.L., Dong, C.X., Xu, Y.C. (2015) Research on the effects of application of straw and pruning branches in pear orchard. J. Nanjing. Agric. Univ., 8: 610-616.
[6] Hu, R.P., Shi, J., Huang, Y.Y., Lin, L.J., Liao, M.A. (2016) Effects of applying hyperaccumulator straw in soil on photosynthetic characteristics of *Galinsoga parviflora* under cadmium stress. Hube. Agric. Sci., 2: 393-397.
[7] Xu, D., Wei, Y., Gao, Y. (2018) Study on selenium accumulation characteristics of *Pterocypsela laciniata*. IOP Confer. Ser. Earth & Environ. Sci., 199: 042025.
[8] Bao. J.F. (2006) Plant Physiology Experiment Guide. Higher Education Press, Beijing, China.