Changes of chlorophyll value and plant height in leaves of different soil materials

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Abstract. The chlorophyll content in leaves can reflect the photosynthetic function of plant leaves. In this study, the chlorophyll content of Arctium lappa L. with different material profiles was monitored by chlorophyll analyzer. The overall trend of chlorophyll was from low to high. After a peak, the chlorophyll content gradually decreased and then tended to be flat. This indicated that Arctium lappa L. grew from early stage of development to maturity and then to decline. The results showed that the SPAD value of chlorophyll in shale + clay and perlite + clay potted plants remained between 8 and 25 from the beginning to maturity. The fluctuation of chlorophyll value was small in the first 20 weeks of monitoring, and increased rapidly in the following 4 weeks. Vegetable carbon and clay fluctuated obviously in the 9th week, and the chlorophyll content was stable and high in the 13th to 16th week. During the whole monitoring period, the content of chlorophyll SPAD in the leaves of all plants did not fluctuate much in the first six weeks, and reached the highest average value in 13 to 16 weeks. The chlorophyll SPAD value of the potted plants reconstructed by the mixture of vegetable carbon and clay remained between 38 and 43, the chlorophyll SPAD value of the potted plants reconstructed by the mixture of vermiculite and clay remained between 20 and 25, and the potted plants reconstructed by the mixture of perlite and clay. The SPAD values of chlorophyll in shale and clay mixtures remained between 8 and 9, the SPAD values of chlorophyll in shale and clay mixtures remained between 9 and 10, and the SPAD values of chlorophyll in whole clay mixtures remained between 21 and 24.

1. Introduction
At present, grain production is a major problem facing our country. In order to ensure the sustained growth of grain production, land consolidation, improvement of land production conditions and improvement of land production capacity are the top priorities of this study. [1] It is found that after land consolidation, the restriction of land production conditions on agricultural production has been basically
solved, but the study of soil fertility is still in the exploratory stage. [2] Therefore, a full understanding of the soil nutrients of newly cultivated land is of great guiding significance for better exerting the effect of land consolidation. In order to explore the characteristics of soil profile configuration with different soil substitutive materials as planting layers, the mixed reconstructions of vegetation carbon, vermiculite, perlite, shale and whole clay in the upper layer of 10 cm, pure clay as control and Arctium lappa L. were used to study the effects of interface treatment between substitutive materials and soil layers on water and nutrients, and the effects of substitutive materials in the surface layer on soil.

Chlorophyll is the material basis of photosynthesis of green plants and the main photosynthetic pigments of leaves. The content of chlorophyll is the main index reflecting the photosynthetic capacity of leaves and the health status of plants. [3] At present, there are two main methods to determine chlorophyll content, one is SPAD chlorophyll meter method, the other is traditional spectrophotometry. SPAD chlorophyll meter can quickly measure the current relative chlorophyll content of plant leaves per unit area without damaging the leaves. SPAD chlorophyll analyzer is not widely used in burdock. Using Arctium lappa L. as material, the author studied the relationship between the change of chlorophyll SPAD value of potted Arctium lappa L. leaves and crop growth in different soil materials, which provided guidance for production practice.

2. Materials and methods

2.1. Natural condition of test site
Tangyu Town, located in the southeast of Meixian County, Baoji City, Shaanxi Province, is located at the foot of Taibai Mountain, the main peak of Qinling Mountains. It has a warm temperate continental semi-humid climate with an average annual temperature of 12.9 C, an average precipitation of 609.5mm, an average sunshine of 2015.2 hours and a frost-free period of 218 days. The temperature difference between day and night is obvious, which is affected by cold air in autumn. It is one of the areas with the most autumn rain in Guanzhong area.

2.2. Test material
In order to explore the characteristics of soil profile configuration with different soil substitutes as planting layers, burdock was planted by mixing 10 cm of vegetation carbon, vermiculite, perlite, shale and whole clay in the upper layer, and pure soil as control. [4] The effects of interface treatment between substitutes and soil layers on chlorophyll SPAD content in leaves and soil stability were studied.

2.3. Test method
The content of chlorophyll in leaves of Arctium lappa L. was determined from transplanting to potting, twice a week, until the plant was harvested. The SPAD value of chlorophyll was determined by chlorophyll analyzer on the 2nd and 3rd leaves (the representative of the main functional leaves) under the top leaves of the robust and insect-free shoots. Three different parts of each leaf were measured, and the average value was finally obtained. [5] The plant height was measured by numbering the three repeated samples in potted plants with different material profile configurations as No. 1-3. The changes of stem and leaf growth were recorded and their growth laws were analyzed.

2.4. Data Statistical Method
All the test data are plotted by Microsoft Excel 2003 software, and all the data in the chart are expressed by mean + standard error. Statistical analysis such as difference significance test of test results was carried out in SAS 9.0 software application. Duncan's new complex gradient method was used for comparative analysis. Different letters showed significant differences at 0.05 level.

3. Results and analysis
From Fig. 1, it can be seen that the content of chlorophyll SPAD in the leaves of shale + clay and perlite + clay potted plants remained between 10 and 12. Through variance analysis, there was no significant
difference in chlorophyll content during this period. The chlorophyll value did not fluctuate much in both vegetative and reproductive growth stages. The SPAD values of chlorophyll in the leaves of potted plants with grass, carbon, clay and whole clay fluctuated significantly between the 2nd and 4th weeks, and peaked at the 9th week, 57.5 and 30.7, respectively. During 12-17 weeks, the content of chlorophyll SPAD in all plant leaves did not fluctuate much. The chlorophyll SPAD values of plant leaves reconstructed with carbon and clay mixture remained between 38 and 44, the chlorophyll SPAD values of vermiculite and clay mixture reconstructed potted plants remained between 22 and 24, the chlorophyll SPAD values of pearlite and clay mixture reconstructed potted plants remained between 9 and 11, and the chlorophyll SPAD values of shale and clay mixture reconstructed pots remained between 9 and 11. The SPAD values of chlorophyll in the planted leaves were between 9 and 10, and those in the potted plants reconstructed by whole clay mixture were between 21 and 23.

![Figure 1. Changes of SPAD value of chlorophyll in Arctium lappa L. in pot experiments with different soil substitutes.](image)

According to the statistics, it can be concluded that Arctium lappa L. grew rapidly from week 1 to week 4. From week 1 to week 2, the plant height of potted plants with different material profiles increased obviously. The plant height of potted plants reconstructed by mixed vegetation carbon and clay increased most obviously by 11.4 cm. The plant height of potted plants changed little from week 2 to week 3. The plant height of potted plants increased obviously from week 3 to week 4, and vermiculite + clay mixed. The plant height in reconstructed potted plants increased by 10.9 cm, and the growth period was slow from the 4th to 5th weeks, and stopped after the 6th week.

4. Conclusion
In terms of plant height and chlorophyll monitoring, the growth of burdock with vegetation carbon as planting layer is the best, and it can be used as soil substitute material. In the next step, we can continue to study the physical and chemical properties of soil with different configurations, obtain the characteristics of soil profile configurations and soil nutrients, and find the best alternative soil materials.

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