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Effects of exogenous calcium on growth, chlorophyll fluorescence characteristics and antioxidant system of *Fraxinus malacophylla* seedlings

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ABSTRACT

Karst ecosystems are becoming increasingly problematic, and high calcium is one of the main characteristics of soils in rocky desertification areas. Chlorophyll fluorescence is one of the most important indicators of the extent to which plants are affected by their environment. There are few reports on the effects of changes in exogenous calcium levels on the chlorophyll fluorescence properties of *Fraxinus malacophylla* seedlings. In the present study, we investigated the growth, chlorophyll fluorescence properties and antioxidant system of *Fraxinus malacophylla* seedlings in response to exogenous calcium (as the concentrations of 0, 25, 50, 75 mmol L^{-1}). The results showed that Ca^{2+} concentration (25–50 mmol L^{-1}) treatment mainly promoted the growth, biomass accumulation, root activity, and chlorophyll synthesis and effect on chlorophyll fluorescence in *Fraxinus malacophylla*; the developed root system became a strong linking hub for calcium adaptation. In addition, the activities of the antioxidant enzymes peroxidase (POD) and catalase (CAT) are upregulated and play an important role in preventing excessive oxidative damage. OJIP test parameters changed significantly with the addition of exogenous calcium, and parameters related to each photosystem II (PSII) reaction centre, such as ABS/RC and DIo/RC, increased significantly in the OJIP test, with enhanced function of the PSII electron donor lateral oxygen evolution complex. In conclusion, the addition of exogenous calcium (25–50 mmol L^{-1}) had an important protective effect on the photosynthetic mechanism of *Fraxinus malacophylla*, promoting photosynthesis, better growth and better adaptability.

1. Introduction

The global karst distribution area is 22 million km^2, accounting for 15% of the land area. The karst mountains are characterised by severe ecological problems such as vegetation destruction and soil erosion in a particular geological and socio-economic context, and rocky desertification, an "ecological cancer", is one of the most serious ecological problems in karst areas (Guo et al., 2013; John and Smith, 1991). The existence of drought and high calcium in rock desertification soil habitats (Wei et al., 2018), with soil calcium levels two to three times higher than in non-karst areas (Liu et al., 2004), has strongly selected for drought-tolerant characteristics and high calcium adaptations of suitable tree species in stone desertification (Tong et al., 2017). In the karst mountains, many plants have been adapted to the local habitat for a long time, producing drought tolerance and calcium adaptability, and the use of these plants for vegetation restoration and ecosystem reconstruction in rock-deserted areas has become one of the hot spots in the study of rock-deserted vegetation.

Calcium is one of the essential nutrients for plant growth and development. The processes of flower initiation, bud differentiation and flowering regulation are closely related to calcium ions (Ca^{2+}), which also help to increase the hardness of the plant stem and plant uprightness. High or low calcium levels can affect relevant physiological and biochemical processes and ultimately lead to plant damage. Low Ca^{2+} concentrations in plants can lead to necrosis of phloem tissues and cause cellular physiological imbalances such as weakened plant growth and leaf necrosis (Adams et al., 1995). Some studies have found that plant leaves can be stunted or leaf margins rolled up when deficient in calcium

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一、项目的技术要求

西南林业大学董琼发表论文被SCI、期刊影响因子（IF）和中科院JCR分区情况（略）

二、情报检索情况：

1. 检索数据库：Science Citation Index Expanded (SCI-E) 网络版
   Journal Citation Reports (JCR)
   中科院JCR分区数据库

2. 检索式：略

三、检出文献情况（编号、名称、文献题目及出处）

（一）SCI收录

第 1 篇

标题：Effects of exogenous calcium on growth, chlorophyll fluorescence characteristics and antioxidant system of Fraxinus malacophylla seedlings

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三、检索结论

依照用户委托，通过国际联机数据库检索，具体结果如下：

（一）SCI 收录：西南林业大学董琼为通讯作者发表的 1 篇论文被 SCI-E 收录；
（二）期刊影响因子见上表；
（四）中国科学院 JCR 期刊分区见上表。

以上检索结论已经清华大学图书馆信息服务中心验证，并可在 SCI-E、JCR、中国科学院 JCR 期刊分区数据库中检索、验证。

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