Mechanisms of the effect of high-performance ester composite materials on plant growth under soilless conditions Postprint

Authors: Qingxiu Zhang, Jin Liao, Zhen Liu, Cuiying Zhou

Date: 2025-07-17T00:00:00+00:00

Abstract

The utilization of high-performance ester materials in addressing soil erosion and conserving water remains a crucial area of research in soil remediation. Currently, however, the mechanism underlying the role of these materials in vegetation restoration remains unclear, hampering the accurate determination of the optimal ratio of high-performance ester composite materials for soil enhancement. To address this issue, this study examines the mechanism of how high-performance ester composite materials affect the germination and growth of plant seeds through soilless cultivation experiments. The results revealed that the high-performance ester composite materials significantly enhanced seed germination ability and fostered plant seedling growth. Notably, the promotional effects of the ester adhesive and water-retaining materials within the high-performance ester composite varied. Specifically, the adhesive material significantly spurred radicle development, while the water-retaining material significantly accelerated germ growth. Varying concentrations of adhesive materials exerted distinct effects on plant growth. In particular, a small amount of adhesive materials enhanced seed germination, whereas excessive amounts exhibited inhibitory effects. Consequently, the optimal adhesive materials dosage conducive to plant growth and the optimal weight ratio of adhesive to water-retaining materials were ascertained. Additionally, the underlying mechanism of high-performance ester composite materials influence plant growth was elucidated. Overall, this research offers a theoretical foundation for the optimal ratio adjustment of high-performance ester composite materials to optimize soil improvement efforts.

Full Text

Mechanisms of the Effect of High-Performance Ester Composite Materials on Plant Growth Under Soilless Conditions

Qingxiu Zhang[1], Jin Liao[1], Zhen Liu[1], Cuiying Zhou[2]

[1] School of Civil Engineering, Sun Yat-sen University, No. 135 Xingangxi Road, Guangzhou 510275, China
[2] School of Civil and Transportation Engineering, Guangdong University of Technology, No. 100 Waihuan West Road, Guangzhou University Town, Panyu District, Guangzhou 510006, China

Abstract

The utilization of high-performance ester materials for addressing soil erosion and conserving water represents a crucial area of research in soil remediation. However, the underlying mechanisms through which these materials facilitate vegetation restoration remain unclear, hindering the precise determination of optimal formulations for soil improvement. To address this knowledge gap, this study investigated the mechanisms by which high-performance ester composite materials influence seed germination and plant growth using soilless cultivation experiments.

The results demonstrated that these composite materials significantly enhanced seed germination and promoted seedling development. Notably, the constituent adhesive and water-retaining components exhibited distinct promotional effects: the adhesive material substantially stimulated radicle development, while the water-retaining material markedly accelerated germ growth. Furthermore, adhesive concentration proved critical, with low doses enhancing germination but excessive amounts demonstrating inhibitory effects.

Consequently, the optimal adhesive dosage for plant growth and the ideal weight ratio of adhesive to water-retaining materials were identified. Additionally, this study elucidated the underlying mechanisms through which high-performance ester composite materials influence plant growth. These findings provide a theoretical foundation for optimizing the formulation of high-performance ester composite materials to enhance soil improvement efforts.

Keywords: High-performance ester composite materials; Seed germination; Plant growth; Influence mechanism; Soilless condition

Note: Figure translations are in progress. See original paper for figures.