

研究论文

酚酸类物质对苜蓿种子萌发及抗氧化酶活性的影响

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摘要 实验选用紫花苜蓿体内的4种化感物质包括阿魏酸、香豆素、香草酸、香豆酸, 以 10^{-3} 、 10^{-4} 、 10^{-5} $\text{mol}\cdot\text{L}^{-1}$ 和 10^{-6} $\text{mol}\cdot\text{L}^{-1}$ 四个浓度, 采用培养皿试纸法和沙培法进行苜蓿种子萌发及幼苗生长试验, 研究了苜蓿种子萌发和幼苗生长以及抗氧化保护性酶活性的变化, 并就生物量、种子萌发和酶活性等三大指标的敏感性进行了讨论。结果表明, 4种化感物质对苜蓿种子萌发及幼苗生长有明显的影响作用, 这种影响效应与化感物质的种类及浓度显著相关。其中, 10^{-3} $\text{mol}\cdot\text{L}^{-1}$ 的4种化感物质均表现出对苜蓿种子萌发有显著的抑制作用, 阿魏酸、香豆素和香草酸达到了极显著的抑制效果。当浓度为 10^{-3} $\text{mol}\cdot\text{L}^{-1}$ 时, 除香豆酸外, 其它3种化感物质均表现出对幼苗体内超氧化物歧化酶(SOD)、过氧化物酶(POD)、过氧化氢酶(CAT)和抗坏血酸酶(APX)活性有显著的抑制作用, 同时使幼苗体内丙二醛(MDA)的含量显著增加; 随着浓度的降低, 化感物质抑制作用减弱; 当浓度降低为 10^{-6} $\text{mol}\cdot\text{L}^{-1}$ 时, 阿魏酸、香豆素、香草酸则表现出了对上述各种酶活性的轻微促进作用。阿魏酸表现出的化感效应最强, 香豆素、香草酸次之, 香豆酸最弱。发芽指标受化感物质的影响最敏感、其次是生物量指标, 而酶活性指标相对较弱。

关键词 [化感作用](#); [化感活性物质](#); [紫花苜蓿](#); [种子萌发](#); [抗氧化酶](#)

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Effects of phenolic acids on seed germination and seedling antioxidant enzyme activity of alfalfa

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Abstract The perennial alfalfa (*Medicago sativa*) is presently used as a forage crop or cover plant to reduce soil erosion caused by wind and water and improve soil quality by nitrogen fixation in many regions of China. But when alfalfa is planted continuously in the same field, its yield will decrease. This is considered to be caused by alfalfa autotoxicity. Allelopathy is one of the important factors which reduce the production of alfalfa. It was reported that some allelochemicals in alfalfa could inhibit seed germination and seedling growth and change root morphology, but the antioxidant enzyme of alfalfa autotoxicity remains largely unknown.

According to previous studies, extracts of alfalfa roots, fresh leaves, and litter include phenolics such as vanillic and ferulic acid, p-hydroxybenzoic, o-coumaric, and p-coumaric acid. Ferulic acid, coumarin, vanillic acid and p-coumaric acid were used to test their allelopathic effect on germination, growth and physiological characteristics of alfalfa in this study. The four allelochemicals were dissolved in distilled water to concentrations of 10^{-3} $\text{mol}\cdot\text{L}^{-1}$, from which, solutions of 10^{-4} , 10^{-5} , 10^{-6} $\text{mol}\cdot\text{L}^{-1}$ were prepared by adding distilled water. The distilled water was used as control. The objective of our research was to test the alteration of antioxidant defense system by using s

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and culture method. So as to better understand the allelopathic action mechanism of different allelochemicals.

The results showed that the four allelochemicals had significant allelopathic effects on seed germination, seedling growth and the activity of antioxidant enzyme, and that the physiological activities were significantly related with the concentration of the allelochemical. The seed germination of alfalfa was significantly inhibited under the treatment of $10^{-3} \text{ mol}\cdot\text{L}^{-1}$ of the four allelochemicals. Ferulic acid, coumarin and vanillic acid at $10^{-3} \text{ mol}\cdot\text{L}^{-1}$ significantly reduced the activities of superoxide dismutase, catalase, peroxidase and ascorbate peroxidase, while the content of MDA in alfalfa seedling was significantly increased. However, ferulic acid, coumarin and vanillic acid could increase the activities of antioxidant enzyme at $10^{-6} \text{ mol}\cdot\text{L}^{-1}$. In generally, the synthetic allelopathic effects of the four allelochemicals on the growth and antioxidant enzymes activities of seedling ranked, from the strongest to the weakest, in the order of ferulic acid, coumarin, vanillic acid and p -coumaric acid.

Key words allelopathy; allelochemicals; alfalfa; seed germination antioxidant enzyme

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