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综合评述

植物镉忍耐的分子机理

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摘要 Cd是植物非必需的微量元素，对植物有很强的毒性.Cd抑制植物细胞生长，抑制氧化磷酸化，引发氧化胁迫，影响光合作用，损伤核仁和影响质膜ATP酶的活力.一些耐Cd植物通过诱导形成螯合肽、金属硫蛋白、植物应激蛋白等抵御Cd毒，也有的耐Cd植物则通过细胞壁固定、液泡分隔、腺体分泌等途径来抵御Cd毒.植物螯合肽合成酶(PCS)相关的一些基因已得到克隆.金属硫蛋白(MT)的克隆基因导入植物，使植物对Cd毒的抗性增加；植物胁迫蛋白可提高植物对Cd毒的抗性，Zn转运蛋白可运转Cd.修饰基因则通过影响主要基因提高植物对Cd的忍耐能力.野生型植物耐Cd毒是多基因控制的，而植物短期的Cd忍耐，则仅受一个或少数基因控制.

关键词 Cd 毒性 忍耐 克隆 转基因植物

分类号

Molecular mechanisms of plant resistance to cadmium toxicity

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Abstract

Cadmium (Cd) is a non-essential trace element for plants, and has strong toxicity at low concentrations. It can suppress the elongation growth of plant cell, inhibit oxidative mitochondrial phosphorylation, induce oxidative stress, inhibit the activities of several antioxidative enzymes, affect photosynthesis by inhibiting ferrous reductase or damaging photosynthesis apparatus, and cause the alteration of chromatin and the change of plasma membrane ATPase activity. In response to Cd stress, the cells of cadmium-resistant plant species can produce a number of proteins such as phytochelatins, metallothioneins and stress proteins to detoxify Cd ions, and efficiently repair Cd damage. The plant cells can also resort to other defense systems to detoxify Cd ions, *e.g.*, the immobilization of Cd by cell wall, exclusion of Cd through the action of plasma membrane, compartmentalization of Cd by vacuolar, and release of plant glands. The phytochelatin synthase (PCS) genes of *Arabidopsin*, wheat and *Schizosaccharomyces pombe* had been identified by using different approaches, and the metallothioneins (MT) in plants was also identified recently. By introducing animal MT genes, transgenic plants could increase the resistant ability to Cd toxicity. Subjected to Cd, plant cells often start to synthesize stress proteins such as heat shock proteins, and the plants having been transformed the stress protein genes could enhance their resistant capacity to Cd ions. It was reported that zinc (Zn) ion-transporting proteins could also transport Cd ion. Some minor genes not conferring tolerance on their own could modify the major gene(s), and enhance Cd tolerance. Cd detoxification in wild type plants could be a complex phenomenon, probably under polygenic control to Cd, while acute Cd stress seemed to be a simpler mechanism, apparently involving only one or a few specific major genes.

Key words Cadmium (Cd) Toxicity Resistance Clone Transgenic plant

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