

研究论文

番茄吸收和积累Cd能力的品种间差异

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摘要 旨在筛选和利用在受污染土壤中可食部位污染物积累水平在食品卫生标准允许范围内的农作物品种 (pollution-safe cultivar, 简称为PSC), 以降低水土环境污染经食物链危害人类健康的风险。研究对象为番茄, 探讨了在一定Cd污染土壤中其果实Cd含量低于国际食品法典委员会 (CAC) Cd最高限值的品种 (Cd-PSC) 存在的可能性。通过盆栽试验研究了36个番茄品种 (包括普通番茄和樱桃番茄两个变种) 不同器官在受不同程度镉污染的土壤中吸收和积累Cd能力的差异。结果表明: (1)在土壤Cd重度胁迫 (13.3mg•kg⁻¹) 和轻度Cd胁迫 (1.1mg•kg⁻¹) 下, 番茄所有器官Cd含量的变异在统计学上均存在极显著意义 (p<0.01), 其中果实Cd含量的范围分别为0.08~0.33mg•kg⁻¹和0.00~0.09mg•kg⁻¹, 变异系数分别达到28.5%和77.9%; (2)在重度胁迫下, 所有供试品种的果实Cd含量均超出CAC标准, 而轻度胁迫下的Cd含量超标率达到19.4%, 说明番茄是易受Cd污染的农作物种类, 其中樱桃番茄的受污染风险特别高, 在轻度胁迫下6个供试品种中有5个超标, 而30个普通番茄品种仅1个超标。因此, 仅在轻度胁迫条件下, 存在着番茄的Cd-PSC, 其中有5个普通番茄品种的果实中未检出Cd, 属于比较安全的PSC, 包括品种No.12、16、24、35和No.36, 可以推荐在土壤Cd污染程度略超国家三级标准或具有潜在受污染风险的区域应用; (3)尽管大多数情况下各营养器官的Cd含量间均呈显著的正相关, 但营养器官与果实Cd含量间均无明显的相关性, 推测Cd在番茄营养器官间和营养器官与果实间的转运途径是不一样的。组织中Cd含量的显著相关性说明该特性可以作为农作物品种的种性特征; (4)与轻度胁迫相比, 重度胁迫下的所有供试品种平均果实生物量上升了7.5%, 一半以上的品种表现出较强的耐Cd能力, 这一特性可能导致因不易察觉土壤的Cd污染状况而增加番茄产品受Cd污染风险。

关键词 [番茄; 受污染土壤; 镉积累; 品种间差异; 食物链污染预防](#)

分类号 [X171](#)

Variations of Cd absorption and accumulation of 36 *Lycopersicon esculentum* cultivars

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Abstract As a new strategy for controlling pollution of agricultural products, a method to use a pollution safe cultivar (PSC), i.e. the cultivars whose edible parts sequester particular pollutants at low enough concentrations for safe consumption when grown in contaminated soil, was conceptualized throughout this study. Thirty six cultivars of tomato (*Lycopersicon esculentum*), including 30 common type and 6 cherry type cultivars, were grown under Cd heavily and lightly exposure in soil, having 13.3mg•kg⁻¹ and 1.1mg•kg⁻¹ Cd concentrations, respectively. The biomass and Cd concentrations in root, shoot, leaf and fruit were determined for the tested cultivars. Main results are shown as follows: 1. Variations of Cd concentrations in root, shoot, leaf and fruit among the tested cultivars had extreme significance (p<0.01) under both heavily and lightly Cd exposure. The concentration in fruit varied from 0.08 to 0.33mg•kg⁻¹ and from 0.00 to 0.09mg•kg⁻¹, with coefficients of variation (CV) being 28.5% and 77.9%, respectively; 2. Under the heavily Cd ex

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posure, the Cd concentration in fruits of all the tested cultivars exceeded the permissible limit of the Codex Alimentarius Commission of FAO and WHO (CAC), and even under the lightly exposure, there were 19.4% cultivars above the limitation. Therefore, planting tomatoes in Cd contaminated soil creates a risk to the consumer. The risk seemed to be especially high for the cherry type cultivars, because there were 5 among the 6 tested cultivars with Cd concentration in fruit higher than the limitation under the lightly Cd exposure, while there was only 1 cultivar exceeding the limitation among the 30 tested common type cultivars. Accordingly, Cd-PSC could be found only under the lower Cd exposure conditions in this study, and cultivars No.12, 16, 24, 35 and 36, whose fruits contained undetectable Cd, should be the safest and the most preferred cultivars as the Cd-PSCs for tomato production in potentially Cd contaminated area (Cd concentration in soil should be lower than $1.1\text{mg}\cdot\text{kg}^{-1}$). 3. Although correlations of Cd concentrations between vegetative tissues were significant in most cases, there was no significant correlation of Cd concentrations between vegetative tissues and fruits, which indicated that Cd transporting pathway between the vegetative tissues and fruits should differ from that of between vegetative tissues. The significant correlations between the vegetative tissues among the tested 36 cultivars signaled also that Cd concentration in tissue should be a genotype-controlled feature at cultivar level. 4. Average fruit biomass of all the tested cultivars under the higher Cd exposure increased by 7.5% compared with that under the lower Cd exposure, and more than 50% of the tested cultivars proved to be tolerant to the higher Cd stress. This trait may result in an increasing risk for tomato product to be contaminated by soil Cd due to the lack of the well-defined apparent symptom indicating Cd contamination in the soil.

Key words tomato; Cd contamination in soil; Cd accumulation; cultivar variation _ pollution-safe cultivar (PSC)

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