研究报告

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外源锌对不同番茄品种抗氧化酶活性、镉积累及化学形态的影响

Effect of exogenous zinc on activity of antioxidant enzyme,accumulation and chemical forms of cadmium in different varieties of tomato

关键词：番茄 锌镉交互 抗氧化酶 镉累积 镉形态

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摘要：采用盆栽试验研究了重金属Cd（10 mg・kg^{-1}）污染下，叶面喷施不同浓度Zn（0、50、100、200和400 μmol・L^{-1}）对2个番茄品种‘4641’和‘渝粉109’生长、抗氧化酶活性及番茄果实Cd形态和积累量的影响.结果表明，喷施Zn后，番茄根、茎、果实干质量和植株总干质量以及体内Cd含量和积累量在2个品种之间的差异达到了显著水平（p<0.05）.外源Zn（≤200 μmol・L^{-1}）提高了2个番茄品种的果实、根、茎、叶及总干质量.随Zn浓度的增加，2个品种根CAT活性以及‘渝粉109’根POD活性先增加然后降低；2个品种根SOD活性则呈先降后升再降趋势.番茄果实中各形态Cd含量的顺序为：残渣态Cd（F_R）> 盐酸提取态Cd（F_{HCl}）> 氯化钠提取态Cd（F_{NaCl}）> 乙醇提取态Cd（F_E）> 醋酸提取态Cd（F_{HAc}）>去离子水提取态（F_W）.适量的Zn（≤200 μmol・L^{-1}）减少了2个番茄品种果实中各形态Cd含量，但高量Zn（400 μmol・L^{-1}）增加了‘渝粉109’果实中的F_E、F_R和‘4641’果实中F_{HCl}及F_R含量.Cd积累量为叶 > 茎 > 根或果实.叶面喷施Zn使番茄根、茎、叶和果实中的Cd含量分别降低了18.6%~41.7%、10.6%~36.7%、5.8%~21.5%和2.3%~12.7%.供试2个番茄品种，无论喷Zn与否，果实Cd含量和果实Cd积累量均为‘4641’ > ‘渝粉109’，植株Cd总积累量则为‘4641’< ‘渝粉109’.

Abstract: Pot experiments were carried out to investigate the influence of different zinc (Zn) levels (0,50,100,200 and 400 μmol・L^{-1}) on the plant growth,activities of antioxidant enzymes,accumulation and chemical forms of cadmium (Cd) in tomato when exposed to Cd (10 mg・kg^{-1}). The results showed that dry weights of fruit,roots, stem and plant,and concentration and accumulation of Cd significantly differed between two varieties of tomato ‘4641’ and ‘Yufen109’ (p<0.05). Dry weights of fruit,roots,stem,leaf,and plant increased when treated with (Zn ≤ 200 μmol・L^{-1}). Activities of catalase (CAT) in roots of both varieties,and activities of peroxidase (POD) in root of ‘Yufen109’ increased first,and then decreased with increasing levels of Zn. In comparison, activities of superoxide dismutase (SOD) in root of both varieties decreased first,and then increased with increasing levels of Zn,and reduced again at 400 μmol・L^{-1} Zn. Chemical forms of Cd in the fruit of tomato were in order of residual Cd(F_R)> hydrochloric acid-extractable Cd(F_{HCl})> ethanol-extractable Cd(F_E)> sodium chloride-extractable Cd(F_{NaCl})> acetic acid-extractable Cd(F_{HAc})> deionized water-extractable(F_W). All chemical forms of Cd obviously decreased after the application of adequate Zn (Zn ≤ 200 μmol・L^{-1}) compared to the control,while F_E and F_R of ‘Yufen109’ and F_{HCl} and F_R of ‘4641’ increased at 400 μmol・L^{-1} Zn treatment. Cadmium accumulations of tomato were in order of leaf > stew > roots or fruit. Cadmium concentration in roots,stem,leaf and fruit of both varieties decreased by 18.6%~41.7%, 10.6%~36.7%, 5.8%~21.6% and 2.4%~12.7% in the presence of Zn when exposed to Cd. Cadmium concentration of fruit and Cd accumulations in fruit were in order of ‘4641’ > ‘Yufen109’ in the presence or absence of Zn,while Cd accumulations in plant were in order of ‘4641’ < ‘Yufen109’.

Key words: tomato interaction of zinc and cadmium activity of antioxidant enzyme Cd accumulation Cd fractions