环境科学学报
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Mn对超富集植物短毛蓼和水蓼生长、Mn吸收及氮素代谢的影响

Effects of manganese on the growth and nitrogen metabolism in hyper-accumulators *Polygonum pubescens* blume and *Polygonum hydropiper* L.

中文关键词：Mn 短毛蓼 水蓼 氮素代谢

英文关键词：manganese *Polygonum pubescens* Blume *Polygonum hydropiper* L. nitrogen metabolism

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作者	单位
于方明	1. 广西师范大学环境与资源学院,桂林 541004; 2. 广西环境工程与保护评价重点实验室,桂林 541004
李燕	广西师范大学环境与资源学院,桂林 541004
刘可慧	桂林电子科技大学生命与环境科学学院,桂林 541004
李明顺	1. 广西师范大学环境与资源学院,桂林 541004; 2. 广西环境工程与保护评价重点实验室,桂林 541004
邓华	1. 广西师范大学环境与资源学院,桂林 541004; 2. 广西环境工程与保护评价重点实验室,桂林 541004
杨栋林	广西师范大学生命科学学院,桂林 541004
周振明	1. 广西师范大学环境与资源学院,桂林 541004; 2. 广西环境工程与保护评价重点实验室,桂林 541004

中文摘要：

采用水培的方法,研究了不同浓度Mn(0.0003、0.5、1、2、4、8 mmol · L^{-1})对Mn超富集植物短毛蓼(*Polygonum pubescens* Blume)和水蓼(*Polygonum hydropiper* L.)叶片铵态氮、硝态氮、游离脯氨酸、可溶性蛋白质含量及氮素代谢关键酶:硝酸还原酶(NR)、谷氨酰胺合成酶(GS)、谷氨酸合酶(GOGAT)和谷氨酸脱氢酶(GDH)活性的影响.结果表明,随着Mn处理浓度的增加,短毛蓼和水蓼的根、茎、叶中Mn含量显著增加(p<0.05),在相同Mn处理浓度下短毛蓼中Mn含量均大于同部位水蓼中Mn含量.在Mn处理浓度小于1 mmol · L^{-1}时,Mn对短毛蓼的株高、株重影响不显著,但对水蓼的影响显著(p<0.05),表明短毛蓼比水蓼更耐Mn污染.Mn处理显著降低了短毛蓼硝态氮含量(p<0.05),提高了可溶性蛋白质含量,浓度为8 mmol · L^{-1}的Mn处理显著提高了水蓼硝态氮、铵态氮、可溶性蛋白质含量及短毛蓼、水蓼游离脯氨酸含量(p<0.05).Mn引起了短毛蓼和水蓼氮素代谢关键酶活性的变化,显著降低了水蓼叶片NR、短毛蓼叶片GS活性(p<0.05);在Mn处理浓度为1 mmol · L^{-1}时,短毛蓼叶片NR活性最高,为对照的1.91倍,而2、4、8 mmol · L^{-1} Mn处理显著降低了短毛蓼和水蓼GOGAT活性(p<0.05).另外,Mn处理显著提高了短毛蓼和水蓼叶片GDH活性(p<0.05),在Mn处理浓度为8 mmol · L^{-1}时,短毛蓼、水蓼叶片GDH活性分别为对照的16.29倍和1.29倍.

英文摘要：

Hydroponic culture was conducted to investigate the effects of Mn on the growth, metal accumulation and nitrogen metabolism in hyper-accumulating plants *Polygonum pubescens* Blume and *Polygonum hydropiper* L..The enzymatic activities of nitrogen metabolism were determined including nitrate reducatse (NR), glutamine synthelase (GS), glutamate synthase (GOGAT), glutamate dehydrogenase (GDH) as well as the nitrate nitrogen, ammonium nitrogen, and free and soluble prolines.The results indicated that the Mn contents rose significantly (p<0.05) in the tissues of both plants with the increased concentrations of Mn treatment.However, Mn levels in *P.pubescens* were always higher than those in the same tissue in *P.hydropiper* L. under the same Mn treatment.The plant height and dry weight of *P.pubescens* were not affected significantly when exposed to Mn concentrations lower than 1 mmol · L^{-1}, but significant changes were found for *P.hydropiper*, indicating that *P.pubescens* is more Mn-tolerant. Compare to the control, the contents of nitrate nitrogen in *P.pubescens* decreased significantly (p<0.05), while the contents of soluble protein increased.The contents of nitrate nitrogen and ammonium nitrogen as well as soluble protein in *P.hydropiper* L. increased significantly in the treatment of 8 mmol · L^{-1} Mn.The contents of free proline in both plants increased compared with those of the control, indicating that free proline played an important role in detoxifying Mn.Both activities of NR in *P.hydropiper* and GS in *P.pubescens* declined significantly (p<0.05) due to the Mn treatment.The activity of NR reached maximum in *P.hydropiper* at 1 mmol · L^{-1} Mn

treatment.The activities of GOGAT in both plant tissues decreased significantly (p<0.05) with the Mn concentrations from 2 to 8 mmol • L^{-1}.At 8 mmol • L^{-1} treatment, the GDH activities in both plant leaves (p<0.05) were 16.29 and 1.29 times of those under control, respectively.