

## 龙葵、大叶井口边草和短萼灰叶对Pb、Cd和As污染农田的修复研究

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Cd-, As- and Pb-Polluted Farmland Remediation Potentials of *Solanum nigrum*, *Pteris cretica* var. *nervosa* and *Tephrosia candida*

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摘要

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摘要 以云南省个旧市重金属污染农田为研究对象,通过野外田间试验研究7种配置种植方式下龙葵(*Solanum nigrum*)、大叶井口边草(*Pteris cretica* var. *nervosa*)和短萼灰叶(*Tephrosia candida*)对Pb、Cd和As的吸收特征,探讨3种植物不同配置方式对Pb、Cd和As复合污染农田的修复潜力。结果表明:供试农田土壤Cd和As含量均超出GB 15618—1995《土壤环境质量标准》中的三级标准。所有不同植物配置种植方式中,龙葵地上部对Cd的吸收量最大,为 $(6.99 \pm 0.25) \text{ mg} \cdot \text{kg}^{-1}$ ,大叶井口边草地上部对As的吸收量最大,为 $(326.98 \pm 93.99) \text{ mg} \cdot \text{kg}^{-1}$ ,短萼灰叶地上部对Pb的吸收量最大,为 $(32.96 \pm 5.65) \text{ mg} \cdot \text{kg}^{-1}$ ,均低于超富集植物的临界阈值(Cd  $100 \text{ mg} \cdot \text{kg}^{-1}$ , As  $1000 \text{ mg} \cdot \text{kg}^{-1}$ , Pb  $1000 \text{ mg} \cdot \text{kg}^{-1}$ )。比较7种植植方式对污染土壤中重金属的提取效率发现,单作龙葵条件下,龙葵地上部对Pb、Cd和As的吸收量最大,年吸收量分别为 $1004.97$ 、 $152.04$ 和 $1534.47 \text{ g} \cdot \text{hm}^{-2}$ ,若将Cd和As污染农田土壤修复达到GB 15618—1995中的三级标准,提取效率分别为 $2.8116\%$ 和 $1.413\%$ 。这说明单作龙葵对Pb、Cd和As复合污染农田具有一定修复潜力,但不适用于修复高浓度重金属污染农田。

关键词: 重金属 植物修复 龙葵 大叶井口边草 短萼灰叶 农田

Abstract: A field trial was conducted in heavy metal-contaminated agricultural land located in Gejiu City, Yunnan Province to investigate characteristics of Pb, Cd and As absorption and Pb, Cd and As contaminated farmland remediation potentials of *Solanum nigrum*, *Pteris cretica* var. *nervosa* and *Tephrosia candida* as affected by planting mode of the plants. The mean concentrations of Cd and As in the experiment soil were both beyond the criteria of Grade III in the "Environment Quality Standard for Soils" (GB 15618-1995). Regardless of planting mode, Cd uptake or concentration was the highest in the shoots of *S. nigrum*, reaching  $(6.99 \pm 0.25) \text{ mg} \cdot \text{kg}^{-1}$ , As uptake the highest in the shoots of *P. cretica* var. *nervosa*, reaching  $(326.98 \pm 93.99) \text{ mg} \cdot \text{kg}^{-1}$ , and Pb uptake the highest in the shoots of *T. candida*, reaching  $(32.96 \pm 5.65) \text{ mg} \cdot \text{kg}^{-1}$ . However, these values are still lower than the threshold concentrations for hyperaccumulators i.e.  $100 \text{ mg} \cdot \text{kg}^{-1}$  for Cd,  $1000 \text{ mg} \cdot \text{kg}^{-1}$  for As and  $1000 \text{ mg} \cdot \text{kg}^{-1}$  for Pb. Comparison of planting modes show that in the mode of *S. nigrum* being planted alone, Pb, Cd and As uptake was all the highest in the shoots of the plant, reaching  $1004.97$ ,  $152.04$  and  $1534.47 \text{ g} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ , respectively. If the Cd and As contaminated farmland is to be remedied up to the criteria of Grade III in the "Environment Quality Standard for Soils" (GB 15618-1995), the phytoextraction rate of Cd and As should be  $2.8116\%$  and  $1.413\%$ , respectively, which indicates that the planting mode of monocropping of *S. nigrum* is a potential method to remedy Pb, Cd and As contaminated farmland, but not fit for remediation of farmlands highly contaminated with heavy metals.

Keywords: heavy metals phytoremediation *Solanum nigrum* *Pteris cretica* var. *nervosa* *Tephrosia candida* farmland

Received 2013-02-02; published 2013-07-25

Fund:

国家环境保护科技项目(E-2007-06);云南省环境保护专项(2007[262])

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