EFFECTS OF MIXED CROPPING FOUR HERBACEOUS PLANTS ON THE PHYTOREMEDIATION OF COMBINED HEAVY METAL CONTAMINATION

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Introduction

With the rapid development of economy, the demand of vanadium increases in the world and the development of vanadium ore mining is prospect (Chen D et al., 2009). However, vanadium ore mining causes various heavy metal pollution. The main pollutants are heavy metal ions (Cu, As, Cr^{6+}, Cd, etc.), high vanadium and radioactive substances, etc (Zhou Z et al., 2010). Co-planting has been proved to be effective to enrich more spices of heavy metal and is a common agronomical practice in many countries (SIRSI, E, 2016). We hypothesized that the coexistence of four herbaceous plants (*Artemisia selengensis turcz, Trifolium repens, Houttuynia cordata* and *Medicago sativa*) could remediate contaminated soil effectively. They were mixed cropped in hydroponic culture system, aiming to investigate the effect of different mixed cropping proportion on removing V, Cd, Cr and Pb, the concentration of which was designed as 14.0, 0.8, 6.0 and 4.0 mg/L, respectively. According to the absolute accumulation in plants, the results showed that the highest content of heavy metals in plants was 17.82mg under the proportion 2:2:4:2. The enrichment ability of four plants was affected significantly by cropping proportion condition.

Methods

The experiment, conducted in modified Hoagland nutrient solution dissolving with NH_4VO_3, $CdCl_3 \cdot 6H_2O$, KCr_2O_7 and $Pb(NO_3)_2$, was design with eight mixed cropping proportions (4:2:2:2, 2:4:2:2, 2:2:4:2, 2:2:2:4, 1:2:3:4, 4:1:2:3, 3:4:1:2 and 2:3:4:1. The proportion is mass ratio of *Artemisia selengensis turcz, Trifolium repens, Houttuynia cordata* and *Medicago sativa*) and replicated four times. The total mass of all plants in each type of culture was 40g. Light-tight plastic containers were used in the experiment, containing 500mL heavy metal-enriched nutrient solution. The heavy metal-enriched nutrient solution was replaced every week and kept continuous aeration. After four weeks, plants were harvested and separated into roots and shoots. About 0.2 g of sub-samples was digested and determined using ICP-OES. The absolute accumulation and extraction of 8 cropping types was calculated.

Results

The result showed that in different cropping types the aboveground tissues and roots of four herbaceous plants made different contribution to the remove of Pb, Cd, Cr and V (Fig.1). The variation trend in Fig.1(

Ⅰ)-(Ⅳ) is similar, indicating that the cropping proportion may have similar influence in the enrichment ability of Pb, Cd, Cr and V. The total accumulation of 8 cropping types were in the order of 2:2:4:2＞2:3:4:1＞1:2:3:4＞2:4:2:2＞4:1:2:3＞2:2:2:4＞4:2:2:2＞3:4:1:2. The highest content of heavy metals in all plants was 17.82mg under 2:2:4:2.

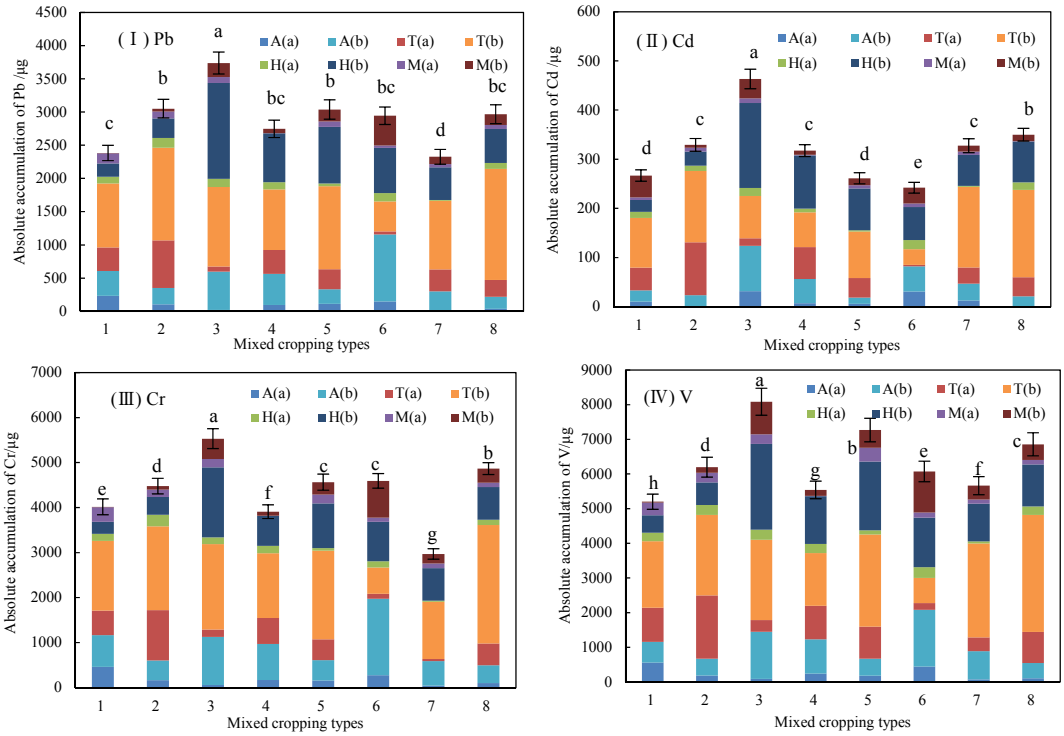

Figure.1 Absolute accumulation of Pb, Cd, Cr and V by aboveground tissues (a) and roots (b) of four plants under different cropping types. Error bars represent ± standard deviation. Values with different letter were significantly different according to the LSD test (p<0.05).

Conclusion

The experiments demonstrated that the absolute accumulation in aboveground tissues of four plants were basically in the order of *Trifolium repens*＞*Artemisia selengensis turcz*＞*Houttuynia cordata*＞*Medicago sativa* and the accumulation and phytoextraction ability was significantly influenced by mixed cropping proportions with other herbaceous plants. The highest extraction was 5.484mg under 2:4:2:2. However, the highest accumulation was 17.82mg under 2:2:4:2 and most of heavy metals was preserved in roots.

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