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Plant Science 2018: Cadmium stress in rice plants: The effect of cadmium on some chemical parameters in rice (*Oryza sativa* L.)- Elham Abedi and Ramazan Ali Khavari-Nejad-Islamic Azad University and Kharazmi University

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The objective of the present work was to evaluate the effect of exogenously applied cadmium on the physiological response of rice (*Oryza sativa*). The study investigated the long-term effect (18 days) of cadmium on the total protein content, malondialdehyde (MDA) content, antioxidant enzymes (peroxidase, catalase) in O. sativa. The treatment was at six levels: 0, 15, 25, 35, 45 and 55 mM $CdCl_2$. Cadmium treatments caused a significant change in the accumulation of soluble protein. Content of protein was significantly declined by rising concentration of cadmium ($p<0.05$). While content of MDA was enhanced by presence of cadmium, the treatment at 35 and 55 $CdCl_2$ mM increased the content of MDA by 77, 89.8% in O. sativa, respectively. Plants with higher amount of MDA under stressful conditions are generally considered as low tolerant to stress. Moreover the content of peroxidase increased with increasing Cd (II) doses up to 15 mM, and had slightly decreased at the concentration of 45 mM. Low doses of cadmium stimulated catalase (CAT) in this plant, with increasing cadmium, however the accumulation of active oxygen in the plant body was beyond the adjustment ability of enzymes, thus this inhibited the CAT activity, so that the CAT activity declined. Heavy metal stress time to plants also have an impact on CAT activity. According to this results O. *sativa* has a low tolerance to cadmium. Also, these results suggest that high concentration of cadmium is more effective on peroxidase in comparison with catalase activity, so peroxidase has an important role in tolerant of these plants.

Introduction

Cadmium (Cd) is among the most toxic heavy metals deposited in agricultural soils through natural means and man-made activities like the application of sewage sludge containing Cd contents, application of phosphate fertilizers, and waste disposal as well as metal smelting. Cadmium toxicity in agricultural soils is a serious threat to crop production worldwide. Even at low concentration and due to its nonessential form in living organisms, Cd becomes highly toxic to both growing plant and animals, thus, affecting plant morphologically, physiologically, and biochemically during growth. Cadmium can be taken up by rice roots and then translocated to shoots and grains of growing rice. The most common visible symptoms of Cd toxicity in growing rice plants include reduction in plant growth and development, chlorosis, and eventually plant death. High Cd accumulation in rice consumed by animals, especially humans, poses several health implications such as cardiac failure, anemia, cancer, hypertension, emphysema, proteinuria, cerebrovascular infarction, damage to the lungs, renal dysfunction in eyes, and osteoporosis.

Rice (*Oryza sativa* L.) is a major cereal crop cultivated and consumed worldwide; it is the second most important cereal crop after wheat in terms of area cultivated and consumption rate. During rice growth, Cd toxicity levels in soils and potential damage to plants are difficult to establish due to the susceptibility and tolerant abilities of some cultivars. Cd translocation from soil to plant organs is an important factor in identifying specific cultivars and concentration level considered toxic for varying rice cultivars. Different cultivars showed differential response regarding Cd uptake and transport under heavy metal stress conditions; however their response does vary based on concentration and cultivar genotypic storage and translocation potential. Soil Cd contamination has tremendous effects on plants as it interferes with plant metabolism and, thus, negatively affects plant growth and development. Hence, Cd

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interaction with essential metals on uptake and distribution in crops is a public concern. The plant cells develop a balanced system to counteract the effect of ROS, such as antioxidative defense system comprises enzymatic antioxidant enzymes like superoxide dismutase, catalase, glutathione peroxidases etc. and non-enzymatic antioxidants which cooperatively reduce oxidative state. Cadmium treatments caused a significant change in the accumulation of soluble protein. Content of protein was significantly declined by rising concentration of cadmium ($p<0.05$). While content of MDA was enhanced by presence of cadmium, the treatment at 35 and 55 $CdCl_2$ mM increased the content of MDA by 77, 89.8% in O. sativa, respectively. Plants with higher amount of MDA under stressful conditions are generally considered as low tolerant to stress. Moreover the content of peroxidase increased with increasing Cd (II) doses up to 15 mM, and had slightly decreased at the concentration of 45 mM. Low doses of cadmium stimulated catalase (CAT) in this plant, with increasing cadmium, however the accumulation of active oxygen in the plant body was beyond the adjustment ability of enzymes, thus this inhibited the CAT activity, so that the CAT activity declined.

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