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MURCIA Food 25

Characterization of Low- Cadmium Accumulating Genotypes in Bread Wheat (*Triticum aestivum L.*)

Haitham Mokhles Saad Khatlan, Mohammed Hamdan Edan Al-Issawi

Department Agriculture of Field crops – College of– University of Anbar- Iraq

Abstract

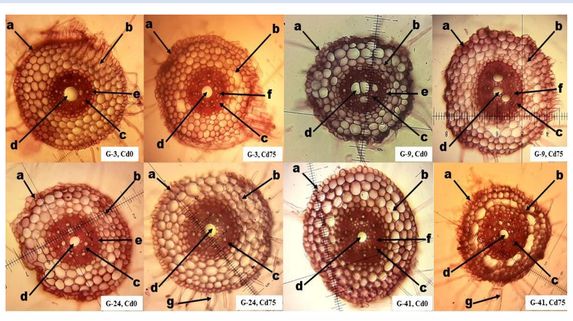
The most important results can be summarized as follows: Anatomical traits were greatly affected by cadmium stress in either two directions. Some of anatomical traits were slightly enhanced such as cortex thickness which can be considered from the clear responses to Cd accumulation in plant tissues. However, the majority of anatomical traits were negatively affected by Cd stress. The genetic background of genotypes has the vital role in the response to Cd stress. The genotype G-3 was superior in terms of its ability to accumulate Cd in its parts of which roots. According to molecular detection of *PCS1* expression and Cd concentration in wheat genotypes parts it is evident that *PCS1* expression is correlated to Cd concentration in plant especially in genotype G-3. It is obvious from chemical analysis to Cd content in grain of wheat genotypes that grain Cd of genotypes G-28, G-29 and Al Diar which cultivated in Cd polluted soils (75 mg Kg^{-1}) was low and within safe limits (0.163, 0.169 and 0.197 mg Kg^{-1} for the aforementioned genotypes respectively). While genotype G-39 recorded the lowest concentration in its vegetative parts and it was within the safe limits (0.19 mg Kg^{-1}).

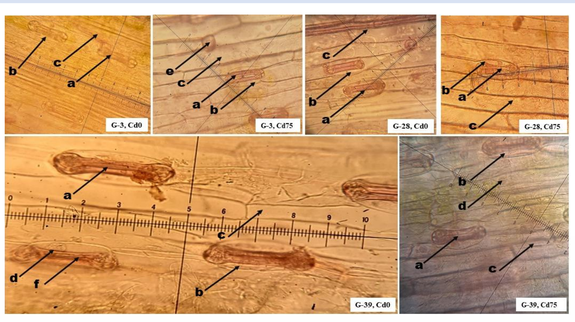
1. Introduction

Iraqi population depends of wheat in their daily life as source of carbohydrates. Every single meal might have one of the wheat products. Based on this, wheat grain safety from pollutants is very important issue for human health especially, the sources of pollutions become very popular due to human unplanned activities. One of the riskiest pollutants is the heavy metals which accumulated in the environment due to the misuse of the fertilizers, pesticides, sewerage which discarded directly to the river without pretreatment, factories waste and war residuals. Since heavy metals pose a threat to human life when they enter the food chain, and given the increasing problem of pollution from these metals in recent times, it has become necessary to focus on stopping the flow of these toxic metals into the human or animal body through the consumption of wheat grains in their various forms. Based on the aforementioned, and due to the importance of food security in terms of production and quality, a field experiment was conducted under the conditions of the western region of Iraq. The aim of the study was to characterize wheat genotypes with low cadmium accumulation that can be used for human nutrition .

2. Materials & Methods

This study included eight introduced genotypes that showed high and acceptable yields under the conditions of the study area, in addition to two locally approved varieties. All genotypes were treated with cadmium (75 mg Cd kg^{-1} soil), in addition to control plants that were not treated with cadmium. Cadmium is one of the most widespread heavy metals, so it was used as an indicator of pollution. It was added in the form of cadmium chloride salt ($ClCd_2.H_2O$, FW:183.33) as a source of cadmium (Thomas Baker Company, Mumbai, India) to the soil along with humic acid, with the aim of making the cadmium available for absorption by the wheat genotypes to study their response to this stress and their genetic ability to absorb, transport, and accumulate cadmium. For this purpose, a randomized complete block design (R.C.B.D) was used in a split-plot arrangement with three replicates for each treatment.



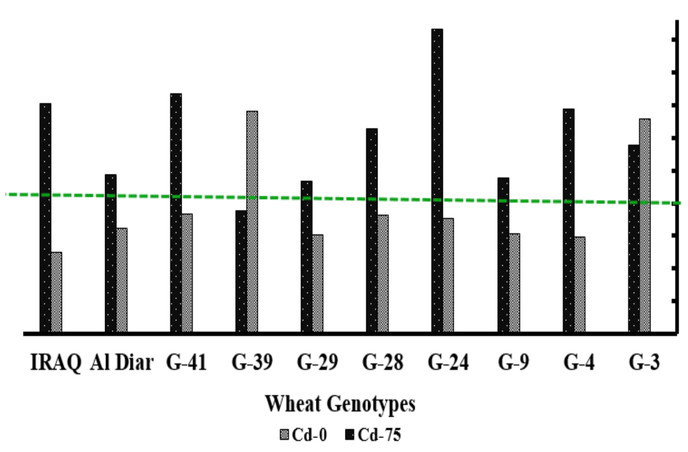


3. Results

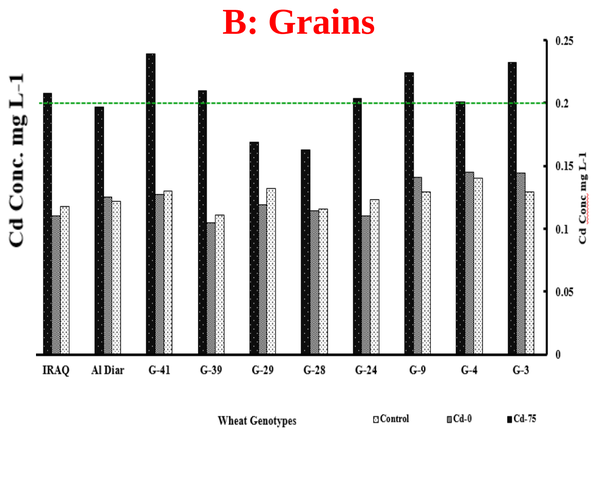
The results of this study concluded that the genotype G-3 was superior in its high ability to accumulate cadmium in plant parts, especially the roots. The results also showed that the cadmium concentration in the grains of the two genotypes G-28 and G-29, in addition to the variety "Diyar," which were planted in soil contaminated with cadmium at a concentration of 75 mg kg^{-1}, was low and within the permissible limits set by the Food and Agriculture Organization (FAO) (0.20 mg Cd kg^{-1} grains). The concentrations were 0.163, 0.169, and 0.197 mg Cd kg^{-1}, respectively. Meanwhile, the genotype G-39 was the only genotype that recorded a low cadmium level in the vegetative parts (stems and leaves), within the globally accepted limit of 0.19 mg Cd kg^{-1}. Based on the abovementioned information, it can be concluded that the genotypes G-28 and G-29 can be used for human consumption, especially since these two genotypes exhibit high and acceptable yields under arid and semi-arid conditions. Meanwhile, the other genotypes that accumulate heavy metals in plant parts other than the grains can be used for other purposes, such as bioremediation of soils contaminated with heavy metals.

From the graphs A and B, it is clear that the cadmium concentration in the vegetative and grains of wheat genotypes varied. Genotypes located under the green line (Figure B) can be used for human nutrition..

A: Vegetative Parts



B: Grains



4- Conclusions

The results showed that all genotypes grown in cadmium-contaminated soil had high cadmium content in their roots. Only genotype G-39 had a low cadmium content in its stems and leaves, within the permissible limits. Meanwhile, genotypes G-28 and G-29, as well as the cultivar Diyar, showed low cadmium content in grains, within the permissible limits. In addition, genotypes G-4 and G-24, as well as the cultivar Iraq, also showed low cadmium content, but slightly exceeding the permissible limits.

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Correspondence: email: ag.mohammed.hamdan@uoanbar.edu.iq, WhatsApp: 00964(0)7716146262

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