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## **V. SUMMARY**

Two pot experiments were carried out under greenhouse conditions at Sakha Agricultural Research Station during seasons 2001 and 2002.

Soil treated with Pb (100, 200 and 300 ppm), Ni (50, 100 and 150 ppm), Cd (3, 6 and 9 ppm) and Combination of this metals (1 comb. , 2 comb. and 3 comb. ppm).

The first experiment aimed to study the effect of aerobic conditions on availability of some heavy metals (Pb, Ni and Cd) in polluted soils with and without barley planting.

The second experiment was carried out to study the effect of anaerobic conditions on availability of the same metals in polluted soils with and without rice planting. Also, effect of metals applications at different rates on yield component and the content of this metals in both barley and rice plants organs.

**The obtained results can be summarized as follows :**

### **1- Yield and yield component :**

- Pb, Ni and Cd had a highly effect of decreasing dry matter of straw and grains for both barley and rice plants at third level of the added concentrations.
- The mean values of the relative reduction for barley straw can be arranged in the following order Comb. > Pb > Cd = Ni . Meanwhile the relative reduction in grains were : Comb > Ni > Cd > Pb.

- The mean values of the relative reduction for rice straw can be arranged in the following order: Comb. > Ni > Cd > Pb, while , in grains were : Comb. > Cd > Ni > Pb.

## **2- Metals concentration in plants :**

- with respect to the effect of Pb , Ni , Cd and combination of this metals, obtained data declared , in general , that Pb , Ni and Cd concentrations in tissues of barley and rice plants progressively increased due to increasing Pb, Ni and Cd concentrations in the root media, whether, this metals added separated or combined form.
- Roots generally, contained highest Pb, Ni and Cd concentrations as compared to shoots, straw and grains for both barley and rice plants.
- Pb, Ni and Cd concentrations in barley plant organs were highest than rice plant organs in both plant growth stages (after 45 days and maturity stages) for all treatments.
- Rice plant appeared highly tolerance for high Pb , Ni and Cd concentrations as compared to barley plant.
- Pb, Ni and Cd concentrations in plant organs of both barley and rice were founds to be slightly highert for metal added to the soil as separated than for combined case.

## **3- Metal uptake by plants :**

- Pb, Ni and Cd uptake by both barley and rice plants organs increased with increasing levels of this metals which added to the soil separated or combined form up to the third level.
- Uptake of Pb, Ni and Cd by barley plant organs was higher than rice plants organs for all treatments.

- The obtained results declared , in general that, straw has accumulated Pb, Ni and Cd more than roots and grains of both barley and rice plants.

#### **4- Translocation of Pb, Ni and Cd within plants organs:**

- translocation of Pb , Ni and Cd within both barley and plants organs (Tc1, Tc2 and Tc3) increased with increasing levels of this metals added to the soil either in separated or combined form.
- Translocation of Pb, Ni and Cd within plants organs (barley or rice) under the second level (Separated or combined) from organs to another more than other levels.
- Pb, Ni and Cd translocation through barley plant organs was found to be higher than rice plants organs for all treatments. The obtained results indicated that the studied heavy metals (Pb, Ni and Cd) translocation coefficients arranged in the following decreasing sequence: Cd > Ni > Pb.

#### **5- Polluted soil with planting :**

- Results showed that available of Pb, Ni and Cd concentrations extracted by DTPA after harvesting for both barley and rice plants increased with increasing amounts of these elements added to the soil separated or combined form.
- Available of Pb, Ni and Cd concentrations in soil after harvesting for both barley and rice plants were found to be slightly highert for these metals added combined form than for separated metals.
- The amounts of extractable Pb , Ni and Cd in soil after barley harvesting were highert than soil after rice harvesting

at all added levels of Pb, Ni and Cd to the soil (Separated or combined).

- Available Pb, Ni and Cd concentrations in soil after harvesting for both barley and rice plants can be descended **in order as follows:**
  - Pb > Ni > Cd whether, these metals added separated or combined form.
- Total contents of Pb , Ni and Cd increased with increasing amounts of these elements added to the soil in separated or combined form.
- After rice harvesting were higher than soil after barley harvesting.

#### **6- Polluted soil without planting :**

- Available of Pb, Ni and Cd concentrations extracted by DTPA increased with increasing amounts of these elements added to the soil separated or combined form and treated with the same treatments of irrigation of planted pots whether, barley or rice plants.
- Available of Pb, Ni and Cd concentrations in polluted pots planted barley or rice plants were highert than pots without planting.
- Available of Pb, Ni and Cd concntrations at all added levels in polluted pots and treated with barley were highert than pots treated with rice plants.
- Total contents of applied metals (Pb, Ni and Cd) increased with increasing these metals added to the soil separated or combined form.