Studies on some heavy metals in soil and plant

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Many heavy metals can find their way to the soil in high rates andso they act as permanent sources of heavy metals pollution forall the typesof life either through the soil or on the earth plant itself.This study aims to investigate the effects due to some of thoseheavy elements that may act as soil pollutants (Zn, Co and Cr) , appliedat high rates on soil and plant.The effects were considered with respect to cotton, carrot, sorghum,wheat, clover and bean, also heavy metals movement and transformationsin soils were evaluated through theses experiments as follows:Exp (I): Germination experiment:This experiment was conducted using a sand culture techniquewhere the germinated seeds were to increasing applications of testedheavy metals, the obtained results showed the following:Zinc applications did not adversely affected the germinationpercentage of bean seeds even at its highest rate (500 mg.kg-l) , whilethe germination of clover, cotton and carrot was reduced with Zn ratesas low as 50 mg.kg-1. Germination of both sorghum and wheat seedswas adversely affected with Zn applications at a rate of 100 mg.kg !.Cobalt applications adversely affected seeds germination in theorderI) Bean•..... 30 mg.kg ! Zn or moreII) Sorghum and wheat •..... 20 mg.kg l Zn or moreIII) Clover, cotton and carrot 1O’mg.kg! Zn or moreChromium application did not adversely affect bean germinationeven at its highest rate of applications. On the other hand the germinationpercentage of all the anther tested seeds (sorghum, wheat, clover, cottonand carrot) was diminished even with the lowest rate of Cr application(lO mg.kg-I)Experiment (II) : Plant growth and utilization ofelements:This experiment was conducted under green house conditions, usingsoils representing the alluvial clay, calcareous and sandy soils. Growth,dry matter yield and concentration (content) as well as total uptake of Zn,Co and Cr by sorghum and carrot plants grown on the above mentionedsoils supplied with increasing rates of these elements were evaluated . Theobtained results showed the following:Dry matter yield:** Dry matter yield of sorghum gained from the tested three soilsrespond to Zinc application in quiet different trends as follows:* In alluvial clayey soil, sorghum plants slightly and progressivelyresponded to Zn applications up to the highest rate (400 mg. kg-1) . wherethe maximum increase (28 %) occurred.* With respect to the calcareous soil, though the maximum increase(18 %) was yielded with Zn application at the highest rate, an increase of(17%) occurred with the application rate of 200 mg. Zn.kg-1 soil only. ** The sandy soil showed a maximum response (140/0) correspondingto rate of Zn application (100 mg.kgr l)** Dry matter yield of carrot, positively responded to Zn application upto limits that different from one soil to another as follows:I) Alluvial clay soil up to 100 mg Zn.kg-III) Calcareous soil up to 150 mg Zn .kg-IIII) Sandy soil up to the highest rate (400 mg. kg-I)Further increases in the rate of application, adversely affected the drymatter yield of carrot in both alluvial and calcareous soils.• • Cobalt application enhanced dry matter yield of sorghum and carrotgrown on the tested soils, where the positive effect lasted till a certainlevel of application according to the following pattern:SorghumAlluvial clay soil : up to 50 mg.kg-lCalcareous and sandy soil : up to 30 mg.kg-ICarrotup to 30 mg. kg-Iup to 40 mg.kg-IWith higher rates of application, the dry matter yield was adverselyaffected.4 •• Except to Chromium application at the lowest rate (5 mg.kg-1) tocarrot grown on the tested soils, all the treatments of Cr with both plantsadversely affected the dry matter yield of plants . This true with respect tothe tested three soils.Elemental content:Concerning the elemental concentration (content) in plants, thevalues of Zn, Co and Cr progressively increased in both sorghum andcarrot grown on the tested soils with increasing the rate of elementalapplication. However, there was only one exception with carrot

grown oncalcareous soil as affected by Co application where its content wasmaximized with application rate of 40 mg.kg-l Co. Further rates reducedthe Co concentration in carrot.Total Uptake:As for total uptake of the tested elements, , results showed that Znand Cr applications at any rate and to any soil (except the highest Cr ratei.e. 25 mg.kg"! in case of the sandy soil) progressively increased the totaluptake of both elements either in sorghum or in carrot, (particularly insorghum shoots in case of Zn) .Cobalt application up to certain level increased the total uptake ofthe element. The higher rates of application yielded an inverse affect. Themaximum application rates 100 mg.kg" 1 that positively affected the totalCo uptake could be shown as follows:Soil : Sandy calcareousSorghum 100 404:arrot 100 30Alluvial clay50 mg.kg!100 mg.kg-ITranslocation in plant:Concerning the rate of elements translocation to upper plant parts(%) results showed more than one trend as follows:Zinc applications to the tested soils enhanced the translocationrate ?f z:n . This was true in case of carrot up to the highest rate ofapplication and up to the third one (l SO mg.kg!) in case of sorghum .Chromium application at the lowest rate reduced the rate of Crtranslocation i.e. the element tended to accumulated in plant roots. Thiswas for both sorghum and carrot grown on all the tested soils.With respect to Cobalt application, the results differed according tothe type of soil and type of plant with an almost constant rate of Cotranslocation in case of the alluvial clay soil.Fe in plant as affected by elemental applications:Results of total Fe uptake as affected by the involved treatmentsshowed the following trends:Zinc as well as Cobalt application at relatively lower rates tendedto increase Fe uptake but with higher application rate of both elements, aninverse trend was obvious.However, there was one exception for carrot growth the alluvial soilwhere Fe uptake was always reduced with Co application at any rate.Chromium application drastically reduced Fe uptake in the alluvialclay soil and to a lower extent in the sandy soil but did not affect it in caseof the calcareous soil.P in plant as affected by elemental applications:Phosphate uptake responded to elemental applications in the followingtrend:Zinc applications up to 1SOmg.kg-I tented to increase P uptake,but with higher rates of Zn application, the reverse was true.Cobalt application adversely affected P uptake in sorghum whileCo induced P uptake of carrot when it was applied a relatively low rates (up to 30 or 40 mg.kg-I)Chromium application negatively affected P uptake under thedifferent treatments tested.Chromium application at the lowest rate reduced the rate of Crtranslocation i.e. the element tended to accumulated in plant roots. Thiswas for both sorghum and carrot grown on all the tested soils.With respect to Cobalt application, the results differed according tothe type of soil and type of plant with an almost constant rate of Cotranslocation in case of the alluvial clay soil.Fe in plant as affected by elemental applications:Results of total Fe uptake as affected by the involved treatmentsshowed the following trends:Zinc as well as Cobalt application at relatively lower rates tendedto increase Fe uptake but with higher application rate of both elements, aninverse trend was obvious.However, there was one exception for carrot growth the alluvial soilwhere Fe uptake was always reduced with Co application at any rate.Chromium application drastically reduced Fe uptake in the alluvialclay soil and to a lower extent in the sandy soil but did not affect it in caseof the calcareous soil.:P in plant as affected by elemental applications:Phosphate uptake responded to elemental applications in the followingtrend:Zinc applications up to 150 mg.kgr l tented to increase P uptake,but with higher rates of Zn application, the reverse was true.Cobalt application adversely affected P uptake in sorghum whileCo induced P uptake of carrot when it was applied a relatively low rates(up to 30 or 40 mg.kgr l)Chromium application negatively affected P uptake under thedifferent treatments tested.Exp (III): Mobility and redistribution of elements:Results of this experiment emphasized the relatively high elementalretention power of both alluvial and calcareous soils (due to activesurfaces) as compared with sandy one. This power was reflected on a verymuch restricted mobility of Cobalt followed by Zinc particularly in thealluvial and calcareous soils.on the other hand, chromium applications (as molybdate) showeda high degree of Cr mobility to an extent that a fraction comprising about54 _ 82 % of the added Cr was leached out of the investigation soilcolumns.