Studies on some factors affecting the implications of applying zinc and copper to the soil-plant system

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The current investigation, included, two pot experiments, to study the effect of source and rate of Zn or Cu on wheat and its content of micronutrients, wheat (Triticum aestivum c.v. Sakha 69) grown on two soils: a sand from Ismailia and a calcareous clay loam from El-Nubareya. Two other experiments were done on the interaction effect of N and each of Zn or Cu using acid-washed sand. All four experiments were done in factorial designs of randomized complete block type.Experiment I:Five kg portions of soil were planted with wheat. Four Zn sources (ZnSO4.7H20, ZnC12, Zn-acetate and Zn-EDTA) were applied at 0, 5, 10 and 20 mg/kg soil. Plants were harvested after150 days.Experiment II:Conducted as experiment I using Cu fertilization. Four Cu sources (CuSO4.5H20, CuC12.2H20, Cu-acetate and Cu-EDTA) were applied at 0, 2.5, 5 and 10 mg/kg soil .Experiment III:This experiment (on wheat) was conducted using acid-washed sand. Portions of 1 kg were used. N was added in two sources [(Ca(NO3. 4H20 and (NI-14)2SO4)] applied at 60 and 120 mg/kg soil. Zn (as ZnSO4.7H20) was applied at 0, 5, 10 and 20 mg/kg soil. Plants were removed from pots after 45 days from plating for analysis of shoots and roots Experiment IV:Conducted as experiment III using Cu instead of Zn. N included the same two N sources and rates. Copper was applied at 0, 2.5 5 and 10 mg/kg soil as CuSO4. 5H20.Results could be summarized as follows: Experiment I:1.Adding Zn increased AB-DTPA extractable Zn (at harvest), with an order of: Zn-EDA > ZnSO4 > ZnC12 > Zn-acetate.2.Grain and straw yields increased by adding up to 10 mg Zn/kg soil, but decreased at 20 mg/kg soil as compared with 5 and 10 mg/kg soil. Zn-EDTA gave the highest yields followed by ZnSO4 > ZnC12 = Zn-acetate, particularly at 10 mg Zn/kg soil. Yield on the non-calcareous sand increased by 23.1 % (grains) and 24.7 % (straw) using 10 mg/kg as Zn-EDTA; in the calcareous clay loam, increases were 14.3 % and 15.5 % respectively.3.Zinc concentration and uptake by plant increased with application of Zn progressing with increased rates of application, with Zn- EDTA giving the highest of all sources and Zn-acetate giving the lowest.4.The concentration of Fe, Cu and Mn in plants decreased upon Zn application particularly with the highest rate of application. Zn-EDTA showed the lowest concentration as compared with other sources followed by ZnSO4, ZnC12 and Zn-acetate. Uptake of Fe, Cu and Mn decreased only at 20 mg Zn/kg reflecting a yield reduction and a competition between Zn and these nutrients.Experiment H:1.AB-DTPA extractable Cu in soils (at harvest) increased upon Cu application, comparison order being: Cu-EDTA > CuSO4 > CuC12 > Cu-acetate.2.Grain and straw yields increased by adding up to 5 mg Cu/kg soil but decreased at 10 mg Cu/kg as compared with 2.5 and 5 mg /kg soil. Cu-EDTA gave the highest yield followed by CuS02 >CuC12= Cu-acetate, particularly at 5 mg Cu/kg soil. Yields of plants grown on the non-calcareous sand receiving 5 mg Cu/kg (as Cu-EDTA) increased by 28.9 % (grains) and 18.3 % (straw), the corresponding increase in the calcareous clay loam were 18.2 % and 14.1 % respectively.3.Copper concentration and copper uptake by grains and straw increased by Cu addition, the higher the rate of application the more pronounced the increase was in Cu concentration and Cu uptake. Cu-EDTA gave the highest and Cu-acetate gave the lowest.4.The concentration of Zn, Fe and Mn in graM and straw of wheat plants decreased with Cu application particularly with the highest rate of Cu. Cu-EDTA showed the

lowest concentration followed by $CuSO_4$, CuC12 then Cu-acetate. Uptake of Zn, Fe and Mn decreased with application of 10 mg Cu/kg soil.Experiment III:1- Zinc application increased dry weight of shoots and roots. The increase progressed with increased rate of application up to 10 mg Zn/kg soil. Shoots increased by 8.1, 13.0 and 8.7 %, and roots increased by 6.8, 10.5 and 5.3 % upon applying 5, 10 and 20 mg Zn/kg soil, respectively.Summary -138-Increasing the rate of N sources from 60 to 120 mg /kg soil increased plant growth. Ammonium sulphate increased dry matter yield of both plant components (shoots and roots) by 9.47 % (shoots) and 9.70 5 (roots) over those fed with $Ca(NO_3)_2$•2. Zinc concentration and uptake increased with Zn application, progressing with the added rate. Increasing N application increased Zn concentration with the superiority of $(NH_4)_2SO_4$ compared with $Ca(NO_3)_2$. Using 20 mg Zn+120 mg N (as $(NH_4)_2SO_4$) gave the highest increase and resulted in increasing Zn uptake by 360 % in shoots and 236 % in roots.Experiment IV:1.Copper application increased plant growth, more so with higher rates up to 5 mg Cu/kg soil. Plant weight increased by 8.5, 13.3 and 5.3 % for shoots and 6.0, 9.0 and 2.2 % for roots considering application of 2.5, 5 and 10 mg Cu/kg soil, respectively. Increasing the rate of applied nitrogen from 60 to 120 mg/kg increased the dry matter of plants.2.Concentration and uptake of Cu by both shoots and roots were significantly increased by application of Cu, more so with higher rate. Increasing the rate of N from 60 to 120 mg/kg soil caused a decrease in Cu concentration in shoots and roots of plants, but Cu uptake in shoots increased; and Cu uptake in roots showed no significant change.3.Concentration of N decreased by Cu application, but uptake of N increased by applying Cu only up to 5 mg Cu/kg soil after which it decreased. Concentration and uptake of N increased by increasing N addition.