

Vodotopiva frakcija Cd, Co, Mn, Ni, Pb i Fe u tlima Osječko-baranjske županije

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Sažetak

Ukupna količina teških metala u tlu ne predstavlja frakciju raspoloživu biljci. Za determinaciju biljci raspoložive frakcije teških metala koriste se metode ekstrakcije neutralnim solima, kiselinama i organskim ekstraktantima. No, neki autori dovode u pitanje opravdanost uporabe ekstrakcijskih metoda zbog slabe korelacije između ekstrahiranih količina teških metala i koncentracija istih elemenata u biljci. Teški metali koji se nalaze u vodenoj otopini, predstavljaju frakciju koja je najpristupačnija biljci. Iako je to frakcija koju biljka najlakše usvaja, ona predstavlja samo dio biljci dostupnih teških metala.

Cilj ovog istraživanja je odrediti vodotopive frakcije teških metala u oraničnom sloju tala Osječko-baranjske županije i istražiti svojstva tala koja utječu na koncentracije teških metala u vodenoj otopini tla. Uzorci su uzeti sa 74 lokacije različitih tipova tala ali isto tako i sa različitih načina gospodarenja (52 poljoprivredna zemljišta i 22 šumska). Rezultati su pokazali korelaciju između teških metala u vodenoj otopini i kiselosti tla (pH), otopljenog organskog ugljika (DOC) i kationskog izmjenjivačkog kompleksa (KIK), dok između teških metala u otopini i ukupnih teških metala nije bilo korelacije. Dobiveni rezultati navode na zaključak da ukupni teški metali nisu najbolji indikator pristupačne najmobilnije frakcije teških metala, frakcije u vodenoj otopini. Srednje vrijednosti ukupnih metala su sljedeće: Fe(29178mg/kg) > Mn(660mg/kg) > Ni(33,11mg/kg) > Pb(19,55mg/kg) > Co(12,5mg/kg) > Cd(0,22mg/kg). Ako te srednje vrijednosti usporedimo sa srednjim vrijednostima vodotopivih metala Fe(12,81mg/kg) > Mn(1,30mg/kg) > Ni(0,04mg/kg) > Co(0,01mg/kg) > Pb(0,006mg/kg) > Cd(0,0006mg/kg), vidimo da su Pb i Co zamijenili mjesta. Dakle, veći postotak kobalta, od ukupne koncentracije, se nalazi u vodenoj otopini nego što je to slučaj sa olovom. Ali moramo biti oprezni kad govorimo o dostupnosti metala biljci jer bioraspoložive teške metale ne određuje samo koncentracija u vodenoj otopini, niti ukupna koncentracija teških metala, već i mnogi drugi biotski i abiotski čimbenici, kao npr. pH reakcija tla. Kiselost tla se u ovom istraživanju kretala od 4,3 do 8,0 (srednja vrijednost je bila 6,3) i pokazalo se da uvelike određuje koncentraciju teških metala u vodenoj otopini. KIK i DOC koji su također pokazali korelaciju s vodotopivom frakcijom teških metala bili su u rasponu 0,013 – 0,244 mol/kg (KIK) i 6,1 – 73 mg/l (DOC).

Ključne riječi: vodena otopina, ukupni teški metali, raspoloživi teški metali, Osječko-baranjska županija

Water extractable fraction of trace elements in the topsoil of Osijek-Baranja County

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Summary

It's well recognised that total metal concentration in the soil does not represent the actual phytoavailable fraction. Several methods, using chemical extractants such as neutral salts, mild acids and organic extractants based techniques, are commonly being used to mimic the plants uptake of metals. However, sometimes even these extraction methods do not correlate with the metals taken up by the plant. The weakest extractant, e.g. water, can give us the idea of the concentration of metal that is already present in the soil solution, and can easily be taken up by the plant. However, the water extractable fraction of metals in the soil is a fraction that may not represent the available fraction for all kinds of plants but in general this fraction is most readily available to the plant.

The objective of this investigation was to examine the concentration of water extractable fraction of metals in the topsoils of Osijek-Baranja County and to assess the relationship between different soil properties and the water extractable fraction. Samples from 74 sites were taken from different soil types under different land uses. Soil was sieved through the 2-mm mesh for the determination of soil pH, DOC, CEC and water extractable heavy metals, while for total heavy metal, samples used were ground to finer particles. Soil pH was determined in the water solution, and the water extractable metals and total metals were determined by ICP-MS and ICP-OES, respectively. Total metals were determined by digestion with HNO₃ and CEC was determined by Barium Chloride method. The statistical analysis was done by using PC application software Minitab. The average concentration of total metal was in the order of : Fe(29178mg/kg) > Mn(660mg/kg) > Ni(33.11mg/kg) > Pb(19.55mg/kg) > Co(12.5mg/kg) > Cd(0.22mg/kg), while the order for water extractable fraction was : Fe(12.81mg/kg) > Mn(1.30mg/kg) > Ni(0.04mg/kg) > Co(0.01mg/kg) > Pb(0.006mg/kg) > Cd(0.0006mg/kg). pH ranged from 4.3 to 8.0 (with an average of 6.3) and its influence on water extractable fraction was significant. Statistical analysis showed that pH, DOC and CEC were significantly correlated with the water extractable fraction while the total metal concentration did not show this relationship. This suggests that the total concentration of metal is not such a good indicator of metal bioavailability to plants; however it is often used as an indicator of toxicity levels. It seems that pH, DOC and CEC play more important role in understanding the heavy metals in the soil solution of Osijek-Baranja County than the total metal concentration.

Key words: Soil solution, Water extraction, Heavy metals, Osijek-Baranja County