



Pollution of heavy metals (cadmium, nickel & lead) in some farms of Torbat-e Jam, east of Khorasan Razavi province, Iran



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Hazards of continued use of chemical fertilizers containing heavy metals:

- o Accumulation of heavy metals in water, air and soil, as a very important environmental problem:
 - Having adverse effects on the fauna and flora of the soil,
 - Reducing crop yield and quality,
 - Bioaccumulation in the food chain and endanger the public health and life of other organisms.

Goals

- o To determine cadmium (Cd), nickel (Ni) and lead (Pb) concentrations in melon (*Cucumis melo* var. inodorus), sugar beet (*Beta vulgaris*) and corn (*Zea mays*), and also in water and soils
- o To examine whether the chemical fertilizers can be a major source of soil and groundwater contamination by heavy metals.

Materials and methods

The heavy metals contents (Cd, Ni and Pb), were measured by atomic absorption in:

- o The soil and water of fields, both before fertilizing and after final harvest (combined sample).
- o The most commonly used fertilizers (triple superphosphate, urea and potassium sulfate).
- o Root (all crops), fruit (melon) and total shoot (corn forage) of all crops during growth season.
- o Bio-accumulation coefficient (BAC) was calculated accordingly.

Triple super-phosphate had a Cd concentration higher than the standards of California Department of Food and Agriculture (4 mg.kg⁻¹).

Concentrations of Cd and Pb in three widely applied chemical fertilizer used in agricultural farms in the study area

Fertilizer	Cadmium	Lead
	(mg.kg ⁻¹)	
Urea	0.01 (±0.005) b	0.01 (±0.003) c
Triple super-Phosphate	5.48 (±0.01) a	2.98 (±0.06) a
Potash	0.031 (±0.005) b	1.05 (±0.008) b

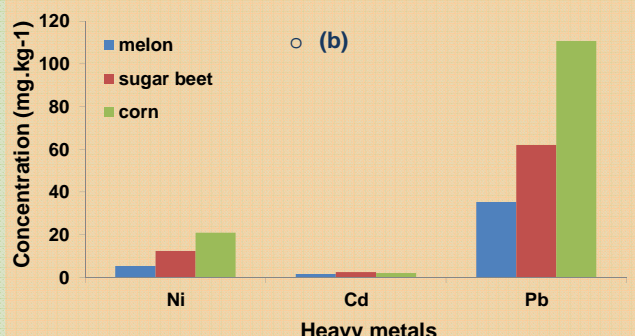
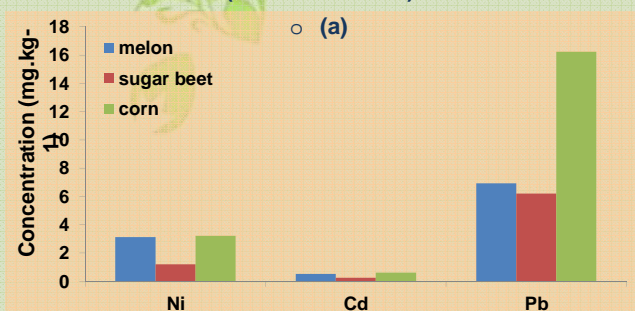
In each column, means sharing at least one letter of level 0.05 were not statistically different.

More chemical fertilizers consumption in corn than the other two crops.

Potential metals added (mg.ha⁻¹.yr⁻¹) to the soils under cultivation of different crops through applying chemical fertilizers in the study area

Crop	Average fertilizer consumption (kg.ha ⁻¹ .yr ⁻¹)			Heavy metals added to the soil (mg.ha ⁻¹ .yr ⁻¹)	
	Urea	Phosphate	Potash	Cadmium	Lead
Melon	120 (±25)	106.67 (±10)	66.67 (±30)	587.75	388.84
Sugarbeet	220 (±10)	120 (±10)	66.67 (±30)	661.86	429.6
Corn	220 (±30)	120 (±25)	106.67 (±10)	663.1	471.47

Ni, Ca and Pb contents in the shoots and roots of maize were more than melons and sugar beet, with the highest transfer coefficient (from soil to root) for Pb.



Average concentrations of heavy metals in the roots (a) and in the consumable organs (b) of melon, sugar beet and corn

- o Unlike to Ni, the Cd and Pb contents in the soil changed significantly before and after fertilization.
- o The total Cd had increased to a greater extent in the soil, than Pb.
- o The total Pb concentration in soils of corn fields showed a greater increase during growth season than other crops, probably due to greater use of potassium fertilizer in corn production.

Concentrations of Ni, Cd and Pb in soils (ppm) before and after fertilizing crop fields in the Torbat-e Jam County, 2011-12

Crop		Ni		Cd		Pb	
		before	after	before	after	before	after
Melon	Mean	6.4	7.1	0.13	1.0	11.36	14.1
	SD	0.73	0.65	0.15	0.10	0.79	0.13
	P- Value	ns 0.21		*0		*0.02	
Sugarbeet	Mean	4.3	4.8	0.06	0.75	13.4	16.1
	SD	0.29	0.21	0.05	0.10	0.97	0.90
	P- Value	ns 0.16		*0.003		*0.007	
Corn	Mean	5.3	5.8	0.1	1.1	12.25	18.98
	SD	0.63	0.59	0.02	0.32	0.70	2.80
	P- Value	ns 0.27		*0.001		*0.04	

Conclusion

- ✓ However, it is likely that continuation of current farm management practices and the excessive use of chemical fertilizers will eventually lead to more pollution and the loss of soil quality.
- ✓ Therefore, in addition to optimal use of fertilizers and control their quality, using of other agricultural methods such as crop rotation, crop residues, green manure, organic fertilizers, and biological control could be assessed in order to mitigate the harmful effects of chemical fertilizer and to approach agricultural sustainability.