The effect of steel industrial residue-enriched soil on the initial growth and heavy metal profiles of elephantgrass

L.P. Passos, M.F. Saldanha, M.C. Vidigal, J.C. De Crignis, S. Sozzi, F.J.S. Lédo and R.C. Oliveira
Embrapa Dairy Cattle, The National Dairy Cattle Research Centre, Juiz de Fora, 36016-210 MG, Brazil, Email: lpassos@cnpgl.embrapa.br

Keywords: contamination, pollution , *Pennisetum purpureum*, heavy metals, steel industrial residue

Introduction Heavy metal contamination of industrial sites are becoming a matter of growing concern. In spite of the substantial progress in the assessment of the influence of steel industrial plant waste on soil and water (Adamo *et al*., 2002), studies on the immediate responses of cultivated plants are still scarce. The objective of this experiment was to verify the short-term effects of soil added phosphate mud (P mud) or metallurgical scale (M scale), which are trace element-rich steel industry residues, on the initial uptake and heavy metal profiles of elephantgrass (*Pennisetum purpureum*).

Materials and methods Seedlings of elephantgrass cv. Napier were grown in soil containing 0, 1, 2, 3 or 4 g/kg of either P mud (with a Fe level of 107,000 mg/kg) or M scale (with a Fe level of 344,000 mg/kg), harvested after a 60-day growing period in a greenhouse. Biomass production was determined as leaf area (L Area, in cm^2), number of basal tillers, and dry weight (DW, in g) of leaves (Lf DW), stems (St DW), stubs (Sb DW) and roots (Rt DW). Heavy metal content in the stem base was measured by the ICP-AES technique (Jung *et al*., 2002). The experiment was conducted as completely randomised block with four replicates.

Results Biomass production was not influenced by either P mud or M scale (Table 1), although a consistent tendency of decreasing Rt DW was observed with enhanced levels of M scale. The number of basal tillers was linearly increased by the addition of P mud. Regarding the heavy-metal profiles in the stem base, the sole significant alteration was a linear augmentation in Zn content in response to P mud application (Figure 1) - approximately, from 30 to 82 mg/kg DW). The contents (g/kg DW) of the other elements ranged as follows: Cd, Co and Mo (0.12 to 1.10), B, Ni and Cu (5 to 70), Al, Cr, Mn, Na and Pb (42 to 215), Ca, Fe and Mg (820 to 1,800), and K (14,000 to 16,200).

Table 1 Effect of residue level (g) on plant variables [#]

g	Residue	L Area	Lf DW	St DW	Sb DW	Rt DW
0		1,882.7	18.1	30.10	6.78	12.54
1	P mud	2,073.9	16.36	25.64	8.93	13.67
	M scale	1,940.5	16.42	21.82	5.21	10.01
2	P mud	2,072.9	12.66	17.36	6.75	13.21
	M scale	1,931.8	18.32	25.98	4.54	8.43
3	P mud	2,062.4	16.57	22.56	7.45	12.13
	M scale	2,028.6	19.05	26.00	5.10	6.66
4	P mud	2,215.7	16.96	23.29	6.94	9.85
	M scale	1,971.6	15.16	18.33	7.07	6.60

[#] All mean differences were not significant (p>0.005)

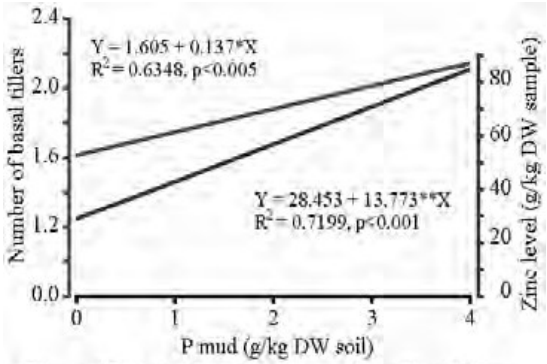

Figure 1 Effect of P mud on the number of basal tillers and on the zinc level

Conclusions Short-term effects on elephantgrass were caused by P mud, but not by M scale. The main responses were an increase in the number of basal tillers and in the stem base Zn content, which reached toxic levels. Considering the available data with other plant species exposed to heavy metal-contaminated soil, further long-term evaluations of the residues examined in the present study could lead to a better assessment of alternatives for soil rehabilitation.

References

Adamo, P., M. Arienzo, M.R. Bianco, F. Terribile & P. Violante (2002). Heavy metal contamination of the soils used for stocking raw materials in the former ILVA iron-steel industrial plant of Bagnoli (southern Italy). *Science of the Total Environment*, 295, 17-34.

Jung, M.C., I. Thomson & H.T Chon (2002). Arsenic, Sb and Bi contamination of soils, plants, waters and sediments in the vicinity of the Dalsung Cu-W mine in Korea. *Science of the Total Environment*, 295, 81-89.