

Effect of soil aeration and genotype on the response of rice to increasing arsenic in mining soils from Ghana



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Background

Wide-spread artisanal gold mining in Ghana results in arsenic contamination of lowland soils. Soil As concentrations decline with increasing distance from the mine. Many of these sites are being reclaimed for food crop production with concomitant risks of yield losses and As contamination along the food chain.



Materials and Methods

Topsoil samples were collected in a lowland Fluvisol from the strongly As-polluted centre and a largely unaffected field site some 300 m downstream at the fringe of a former artisanal gold mining site in Ghana. The samples represent five positions along a gradient with soil As contents of 0, 19, 36, 57 and 76 ppm As. Potted soils were subjected to either field capacity or permanent soil flooding and planted with the P-efficient rice genotype Mudgo and the Pinefficient genotype IR64 in a greenhouse. After 6 weeks, rice plants were harvested and analyzed for As and P contents by ICP-MS.

We assessed the role of rice genotypes and soil aeration status (aerobic vs. flooded) on performance attributes of P efficient "Mudgo" and P-inefficient "IR64" along an As-contamination gradient of gold mining soils. Artisanal gold mine in Ghana



Selected attributes of the experimental soils

Soil	рН (H ₂ O)	C _{org} (%)	N _{tot} (%)	Zn (mg/kg)	Cd (mg/kg)	P (mg/kg)	As (mg/kg)
Reference soil	6,23	2,68	0.19	32,4	<1	12,9	0,2
25% mining soil	6,49	2,10	0.14	40,5	6,0	9,8	19,2
50% mining soil	6,76	1,97	0.10	48,6	11,1	6,7	38,2
75% mining soil	7,03	1,34	0.09	56,7	16,7	3,6	57,1
Pure ining soil	7,30	0,69	0.08	64,8	22,2	0,5	76,1



Conclusions

Increasing soil As reduces rice biomass and P uptake



Effect of increasing soil As concentration on rice plant height and biomass accumulation

Negative effects are more in aerobic than in flooded soils

P efficient genotypes are less affected by high soil As

Cultivate former gold mining sites with P-efficient lowland rice !

Effect of increasing soil As concentration on rice As concentration and As uptake





sa attribute

Relationships between soil and plant As contents as affected by genotype and soil aeration status



P efficient "Mudgo" and P-inefficient

Please help yourself

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Effect of increasing soil As concentration on rice P concentration and P uptake

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