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Application of water treatment sludge

in degraded soil: micronutrients

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INTRODUCTION

Water for municipal use are produced by conventional treatment processes which include the addition of a coagulant during a rapid mixing period, flocculation of soils during a slow mix period, and then separation of the solids by means of sedimentation and filtration processes. These solids are termed water treatment sludge. The water treatment sludge is returned to a watercourse without further treatment. The alternative of the disposal final from the water treatment sludge the disposal in land application, cement manufacturing, brick making, turf farming, composting (with yard waste or biosolids), commercial top soil and potting soil production and forest land application (AWWA, 1999).The application of the water treatment sludge in degraded soil resolves the problem of the disposal of the residual that at this moment is discarded in the watercourse and is an alternative for recuperation area degraded. The objective of this study was evaluate micronutrients in degraded soil of the mining of the cassiterita in Jamari Rondonia Forest National treaty with water treatment sludge.

MATERIAL AND METHODS

A greenhouse design was developed using pots filled with the mining degraded soil from the Jamari Natural Forest in Rondonia, Brazil. The degraded soil was air-dried, and 5 mm sieved. A summary of some physico-chemical properties were: pH ($CaCl_2$) = 4.9; Organic matter = 3 g dm^{-3}; P(resin extractor) = 8 mg dm^{-3}; K = 0.5 mmol$_c$dm^{-3}; Ca = 5.0 mmolc dm^{-3}; Mg = 2.0 mmolc dm^{-3}; H+Al = 12 mmolc dm^{-3}; S = 7.5 mmolc dm^{-3}; T = 19.5 mmol$_c$dm^{-3} and V = 38%. The analysis of physico-chemical properties of water treatment sludge: humidity: 98%, total organic-C 10.51(g kg^{-1}); total-N= 2 (g kg^{-1}); P= 1(g kg^{-1}); K= 2.2 (g kg^{-1}); Ca= 121 (g kg^{-1}); Mg= 4 (g kg^{-1}); S=4 (g kg^{-1}); Fe= 167040 (mg kg^{-1}); Zn= 65.6 (mg kg^{-1}); Cu= 149 (mg kg^{-1}); Mn= 1682.5 (mg kg^{-1}); Pb= 8.4 (mg kg^{-1}); Cr= 86 (mg kg^{-1}); Ni= 27 (mg kg^{-1}); Cd= 6 (mg kg^{-1}); clay =260 (g kg^{-1}); silt= 315 (g kg^{-1}); total sand= 425 (g kg^{-1}). The experimental design was entirely randomized with five treatments and four repetitions. The treatment was T1 = control, T2 = treatment chemical (soil degraded with 2 Mg ha^{-1} of the dolomitic limestone), and 100, 150 e 200 mg de N/ kg of soil degraded , respective 3400, 5000 e 6700 g de water treatment sludge moist for pots. The pots were supplied with five kg of degraded soil obtained from tin mining area. In function of humidity of water treatment sludge (90%) the application was fragmented in fifteen days make serve as a base in water holding capacity of soil degraded. After the application of half dose and in final of the application, sludge was incorporated in the total volume of the pots. The whole material was ground in soil mill, homogenised placed into pots. Dolomitic limestone (2 Mg ha^{-1}) was applied to all the treatments to correct the pH, except in control. The pots were incubated 30 days at 70% of their water holding capacity under greenhouse conditions. Before transplant of seedling soil was fertilised with NPK in the pots containing the chemical control treatment. The pots get receive water treatment sludge received a complementary fertilisation with NPK in order to have same NPK content of the chemical control (200 mg N, 300 mg P and 150 mg K per pot), according Franco (2000).

All the pots, except the control, were fertilised with a micronutrient solution (Melo et al. 1998). After this plants of *Senna multijuga* previously germinated in washed sand were transplanted to the pots (three plans per pot) and conducted by 120 days. After this period the plant were remove and *Brachiaria decumbens, Panicum maximum cv tanzânia, canavalia ensiformis and Stilozolobium aterrimum* were transplant to the same pots and left to growth for 60 days.

After this time soil sample were taken from the pots and analysed for micronutrients content (Raij et al., 1996).

RESULTS AND DISCUSSION

The application of WTS increased the micronutrients content in degraded soil, yet that pH is high (pH= 8.0). Following Camargo et al. (1982), increases in pH soil, not even showed reduced of micronutrients availability. The Fe content and Cu are considerate high and Mn low (Raij et al. 1996).

The Fe contents increased of 3 in Ta (absolute control) for 58.80 mg dm^{-3} in D$_{200}$. The increase in iron content to mind the relation rate-effect. Toward the Zn contents not had significative difference between the rates. It had interactions between plants and rates of WTS. In plots cultivated with *Brachiaria decumbens* to happened the mayors contents of Zn in soil in D_{200} , likely a due to lower production of dry matter (Table 2).

The content of Cu increased linearly with addition of WTS. It was not to observe effect of culture of plants in Cu contents. Following Malavolta et al. (1997), in presence of high contents of Ca , can to occur antagonism between Ca and Cu, with the Ca to impede the exaggerating absorption of Cu.

0.1 It to observed increases in contents of Mn with addition of WTS. The D_{200} showed the major contents and the Canavalia ensiformis was the plant that if showed more exigent in Mn. The lower contents of Mn can have happen in function of increase of pH due to reduce of hidrogenionic concentration that favour the conversation of Mn exchange in forms insoluble with Mn^{3+} e Mn $^{4+}$ (Malavolta et al., 1997).

The low contents of B fended in treatments that received WTS can be due to pH and quantity of lime adds in soil through of sludge. Following Moreira et al. (2000) the adsorption of B is significative increase in the conditions.

Table 1- Content of Fe, Cu, B, Zn and Mn in degraded soil 210 days after application water treatment sludge.

0.1.1 Means followed by the same letter in the same column different by Tuckey test at P = 5% D_{100}, D_{150} e D_{200} to correspond rates of 100, 150 and 200 mg de N/ Kg degraded soil in sldge form WTS.

Table 2- Contents of Zn in interaction between plants and rates os water treatment sludge in degraded soil by tin mining

0.1.2 Means followed by the same letter, capital letter in vertical and minuscule letter in horizontal, between differ by Tuckey test at P = 5%

Conclusion

Treatments	Cu	Fe	Mn
	——————mmol$_c$ dm^{-3}——————		
Controls	0,48 b	3,13 b	0,90 b
Factorial	1,54 a	50,38 a	2,58 a
Test F	125,83 **	1869,78 **	138,37 **
Controls			
Absolute control	0,10 b	3,00 a	0,85 a
Chemical controls	0,85 a	3,25 a	0,95 a
Test F	17,64**	0,01 ns	0,14 ns
Rates			
D_{100}	1,24 c	42,90 c	2,16 b
D_{150}	1,54 b	49,45 b	2,39 b
D_{200}	1,85 a	58,80 a	3,20 a
Test F DMS (5%)	29,18 ** 0,19	151,47 ** 2,22	40,95 ** 0,29
Plants			
Stizolobium aterrinum	1,48 a	53,58 a	2,88 a
Panicum maximum cv tanzania	1,58 a	49,75 b	2,37 b
Senna multijuga	1,46 a	49,25 b	2,75 ab
Canavalia ensiformis	1,58 a	49,33 b	2,33 b
Brachiaria decumbens	1,61 a	50,00 b	2,58 ab
Teste F DMS (5%)	0,83 ns 0,29	4,69 ** 3,35	4,62 ** 0,44
Interaction rates x plants	0,53 ns	0,81 ns	1,62 ns
CV (%)	17,83	6,48	15,93

Plants	D_{100}	D_{150}	D_{200}
	——————mg/kg——————		
Stizolobium aterrinum	2,23 Aa	2,83 Aa	2,55 Ba
Panicum maximum cv tanzania	2,50 Aa	3,08 Aa	2,25 Ba
Senna multijuga	2,30 Aa	2,98 Aa	2,15 Ba
Canavalia ensiformis	3,53 Aa	2,48 Aa	2,38 Ba
Brachiaria decumbens	2,65 Ab	3,48 Aab	4,20 Aa

The application of WTS increase the contents of micronutrients in degraded soil and soil pH, but WTS isolated not is sufficiency for recuperation degraded area.

0.1.3 Reference

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