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Reforestation and landscape reconstruction in gypsum mine area from the semiarid region of NE Brazil

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In the Araripe region, Northeast Brazil, exist the world's second largest reserve of gypsum, estimated at over than one billion tons, which accounts for 95% of the Brazilian production and constitutes an important segment of the regional economy. The gypsum deposit occurs in the Lower Cretaceous Santana Formation of the Araripe basin, which is constituted by siltstones, marls, limestones, shales and gypsum layers. The ore extraction is from an open pit, on simple benches with a height of about 15 meters. Activities in mining operations involve stripping, drilling, loading explosives, blast, fragmentation and block loading / transport. Currently, gypsum mining and processing results in major changes in the landscape (pits and wastes heaps sedimentary rocks and soil mixture), deforestation of the "caatinga" ecosystem for use as firewood in small calcinations, dust pollution and changes in hydrology. To promote environmental remediation of this area, a multidisciplinary research has being done with the aim to support reforestation at the wastes heaps. The study involved the following activities: collection and physical, chemical and mineralogical characterization of mine waste materials; a floristic survey around the mines (botanical identification and measuring physical parameters in 16 plots, in order to identify which species are best suited to the conditions of the substrate at the mine site); an experiment (randomized block design) developed in a greenhouse, where seedlings of various native tree species were grown in a "constructed soil" made up of gypsum waste combined with chicken, goat and cattle manure, aimed to select tree species and soil treatment to be used in a waste heap; and an assessment of water quality for irrigation of the reforestation areas. The waste materials consist of large clayey aggregates, which may present physical/chemical properties unfavorable for plant development. The mineralogy of the sand fraction ($>$ 85% quartz, gypsum and aggregates with carbonate, clay, ferrous and/or manganese oxides) indicates a low potential reserve of plant nutrients. The clay mineralogy, with the presence of 2:1 minerals, explains the high CEC (60.95 $cmol_c$ dm^{-3}). Moderately alkaline pH is above the desirable range. P (282 mg kg^{-1}) is high, while N (0.3 g kg^{-1}) is low. ESP $<$ 4% classifies the waste as non-sodium and the EC (60.95 $cmol_c$ dm^{-3}) reflects mainly the Ca. The low values of soil organic matter (3,56 g kg^{-1}) indicate the relevance of using organic amendments for the reconstruction of the soil for plant growth. Based on these data a forestation experiment (randomized block design) was done on a large waste heap preserved for scientific research, where 500 tree seedling were planted (9 different species) in a plot of 134 m x 60 m in size.Two substrates treatments were used: block with 1.4 kg organic matter per plant hole and blocks without organic matter. The preliminary statistical data show good responses to the treatments. This constitutes a way to transform gypsum mining wastes into soil. Application of these technologies for environmental rehabilitation can be used in other problems.