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Comparison of soil amendments for reforestation with a native multipurpose tree under semiarid climate: Root and root tuber response of *Spondias tuberosa*

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ABSTRACT

The Caatinga biome, characterized by a species-rich seasonally dry tropical forest, but highly disturbed covers most of Brazil's Northeast. Endemic to this biome is the multipurpose tree *Spondias tuberosa* Arr., which forms numerous root tubers to resist drought stress. In order to develop improved soil management for reforestation with *S. tuberosa* the response of its root system to different soil amendments was studied with 52 seedlings, using goat manure, clay substrate, biochar as soil amendments, and mineral fertilizer. The default root architecture of three-year-old *S. tuberosa* and the relation between soil physical parameters and fine root dry matter (≤2 mm), root length density, root tuber volume, root tuber fresh weight, and shoot-root ratio were analyzed.

Seedlings still formed a tap root with a maximum rooting depth of 63 cm and a maximum horizontal extent of 35 cm, developing 2–4 root tubers per seedling. Fine root dry matter in 3000 cm^3 soil samples differed significantly, ranging from 0.23 g in the control to 0.03 g in the treatment combining manure with biochar and mineral fertilizer. According to the orthogonal contrast, manure was the pivotal soil amendment affecting fine root dry matter negatively. Simultaneously, manure application led to increased soil water content compared to treatments without . The shoot-root ratio increased by 32% compared to the control, when *S. tuberosa* was grown in wet soils. Root tuber growth was significantly enhanced by manure addition. This effect is attributed to a reduction of soil bulk density as root tuber volume exhibited a negative correlation with soil bulk density. There was no statistical relationship between root tuber volume and seedling survival during the field experiment. Compared with the control, neither clay, biochar nor solely mineral fertilization significantly affected root growth.

Soil management focused on improving water availability is suspected of hampering fine root growth of *S. tuberosa* seedlings, whereas reducing soil bulk density enables better root tuber development and could, therefore, be a promising measure to increase *S. tuberosa* drought resistance in the long term for more successful reforestation. Disregarding its negative impact on fine root growth, we assume manure is the most promising amendment among the tested treatments, due to its positive effect on root tuber growth.