SOIL FERTILITY AND CARBON STORAGE UNDER EUCALYPT STANDS IN PORTUGAL

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ABSTRACT

Knowledge of soil fertility is essential to plan and carry out fertilization requirements of eucalypt plantations. In Portugal, the most relevant parameters include the soil's pH and the availability of N, P, K, Ca and Mg. This information can also be useful to ensure soil's productive capacity is maintained over time, as well as to quantify the soils status as carbon sink. In this paper we compiled, in a GIS environment, a large soil quality dataset and produced a national status of soil's fertility and organic carbon retention under eucalypt stands.

The dataset includes a total of 2457 soil samples, with depths up to 40 cm, and containing measurements of at least one of the following variables: pH in water, organic matter, extractable phosphorus and exchangeable bases (potassium, calcium and magnesium). Datasets were compared with reference levels for eucalypt growth in Portugal and the percentage of samplings within each class was calculated.

Eucalypt plantations are mostly located in moderately acidic (almost 60% of sampling points) and acidic soils (40%), with soil's pH magnitude between 4 and 6.5. Nitrogen availability, estimated throw soil organic matter, is low or very low for more than 50% of the soils (less than 40 $kg.ha^{-1}.year^{-1}$), corroborating eucalypt frequent response to maintenance fertilization with this nutrient. The levels of extractable phosphorus were, to a large extent, low or very low (less than 10 $mg.kg^{-1}$), corresponding to almost 90% of the total samples. These results support the practices of fertilization at planting with this nutrient. For exchange potassium, more than 40% of data has an average soil concentration, with only 22% below this level (less than 0.10 $cmol.kg^{-1}$). Levels of calcium concentration were evenly distributed between fertility levels, with low to very low (<0.35 $cmol.kg^{-1}$), medium and high to very high, having one third of the plots in each class. For both nutrients, response to fertilization is therefore very site specific. Magnesium is a nutrient that is generally abundant in forest soils in Portugal. Only 2% of data has concentration lower than 0.05 $cmol.kg^{-1}$, very low fertility level, and 8% below 0.10 cmol.kg-1, low fertility level.

Regarding carbon's storage in the soil, almost 30% of soil datasets showed carbon storage below 50 $t.ha^{-1}$ and another 30% between 50 and 100 $t.ha^{-1}$. About 20% were between 100 and 150 $t.ha^{-1}$ and the remaining samplings had higher values.

Estimating soil fertility or carbon storage can be challenging given nutrients complexity and their functioning dynamics in the ecosystem, depending on different aspects of soil formation and being specifically affected by human intervention. The approach allowed to validate nutrient guidelines in fertilization programs for eucalypt and quantify soil's richness on nutrients for plants and its capacity to storage carbon.

Keywords: soil fertility, soil carbon storage, eucalypt plantations.