Site classification of commercial eucalypt plantations in the Congo. Use of layer depths and microelement deficiencies as productivity indices

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Introduction

Since 1978, 42,000 ha of clonal eucalypt plantations have been established in the Pointe-Noire region for pulp production. The soils are sandy, acidic, very poor in reserves of available nutrients, and the benefit of applying NPK to the plantations has been shown. However, despite NPK fertilization, marked differences of production ($10 \rightarrow 2.5 \text{ m}^3 \text{ ha}^{-1} \text{ year}^{-1}$ at the end of stand rotation) can be observed between sites with comparable soil characteristics: texture, pH, some of cations, cation exchange capacity, phosphorus, total carbon and total nitrogen. So, a need of relevant site classification indices exists and has conducted to set up a pot experimentation in order to assess, in particular, microelement deficiencies.

Material and methods

Three sites of a topographic sequence were chosen (plateau, slope, valley-bottom). In each of them, 3 layers (A_1 , B_{21} , B_{22}) were sampled to 3 meters depth, after a pedological examination. Nine treatments were then applied for each of these 9 soil samples: T_1 -control non fertilized; T_2 = NPKCaMgS; T_3 = T_2 + (B+Cu+Fe+Mn+Zn+Mo); T_4 = T_3 -B; T_5 = T_3 -Cu;...; T_9 = T_3 -Mo. Ray-grass (Lolium multiflorum) was chosen as the test-plant, 2.2 g of which was sown per pot (1 kg of soil); crops were harvested 4 weeks after sowing. These operations were repeated 4 times which is considered sufficient to cause the possible soil nutrient deficiencies to be exhibited. The experimental design consisted of 3 complete blocks. The traits measured were dry biomass (DB_i) produced at the end of each rotation i, and cumulated production (DB_{icum}).

Results

Soil analyses

The analyses carried out show that the sites differ by the depth of the different layers (cf table 1) but not by the chemical characteristics of these layers.

Pot experimentation

When all the levels of the factors are taken into account, significant differences exist between treatments (1), sites (2), layers (3), and there is a significant site* layers interaction (4).

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Table 1: depth and colour of the different layers on the three sites.

Layers	Colour	Plateau	Slope	Valley-bottom
A ₁	Dark to dark-grey	0-60 cm	0-50 cm	0-70 cm
A/B	Yellowish brown	60-70 cm	50-80 cm	70-120 cm
B_{21}	Yellow	70-200 cm	80-170 cm	120-210 cm
B ₂₂	Ochre	200-300 cm	170-300 cm	210-300 cm

(1) Control treatment exhibits a significantly lower production (DB_{4eum}= 2.89g). The other treatments are not significantly different. However, it is observed that production of T_2 is slightly lower (DB_{4eum}= 4.47g) than those obtained with the other fertilisations (mean DB_{4eum}= 4.58g). (2) There are significant differences between valley-bottom (DB_{4eum}= 4.51g) and the other sites (DB_{2eum}= 4.36g for plateau and 4.28g for slope). (3) B₂₂ production is significantly lower: DB_{4eum}= 4.31g vs 4.42g for A₁ and 4.43g for B₂₁. (4) B₂₂ production is significantly lower only on slope: DB_{4eum}= 3.97g vs 4.26g for A₁ and 4.47g for B₂₁.

Without fertilisation, all the layers are significantly different: DB_{4cum} := 3.09g for A_1 vs 2.86g for B_{22} and 2.72 for B_{21} . With T_2 (= NPKCaMgS), the production of the slope is significantly lower: DB_{4cum} = 4.23g vs 4.57g for valley-bottom and 4.60g for plateau. This lower production could be explained by microelement deficiencies: with T_3 (= T_2 + microelements) the three sites are not different, the increase of production vs control being equivalent (1.64g - 1.68g).

Discussion and conclusion

Pot experimentation seems more adapted than soil analyses to underline the differences in soil fertility. The better fertility of A_1 layer, the most prospected by roots, could partly explain the differences in stand production observed in the commercial plantations: the depth of this layer – and of the transition layer A/B - differs noticeably between sites. The A_1 layer depth could be therefore used as a site classification index. The lower stand production on slope could be also explained by microelement deficiencies.

Field experiments will be carried out to confirm these first results, during year 2000. (1) It will be calculated correlation between the production of 50 stands, planted with the same clone, and the depth of the A₁ layer (2) Another pot experimentation will be conducted to identify the microelement(s) deficient on slope. These results will be also presented.

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ABSTRACTS

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