Soil Characteristics of *Leucaena Leucocephala* Stands with Different Densities

W.L. Huang, Z.Y. Lie, L. Xue* & J. Li

*College of Forestry and Landscape Architecture, South China Agricultural University, Guangzhou 510642, P. R. China*

**ABSTRACT:** Soil characteristics of *Leucaena leucocephala* stands with different densities were studied. The results showed that soil pH, total P and available K were significantly smaller than the controls, whereas their total N was significantly greater than the control in all density stands. Compared with the controls, soil organic matter was significantly increased in 2 trees·m⁻² stand, soil total K significantly decreased and available N significantly increased in 4 and 8 trees·m⁻² stands; Soil available P significantly increased in 2 trees·m⁻² stand. Soil Urease activity in 4 and 8 trees·m⁻² stands was significantly greater than the control, phosphatase activity was significantly smaller than the control in 2 trees·m⁻² stand, whereas catalase activity was significantly smaller than the controls in the three density stands.

1. **INTRODUCTION**

Soil is the substrate for forest growth, and soil physical and chemical properties have important effect on the growth and development of forest. Although there are many researches on forest soil (e.g. Lu et al., 2008; Chen et al., 2010), little is known about the effect of stand density on soils. Xu et al. (2008) and Yi et al. (2013) reported the soil fertility of young *Acacia auriculiformis* stands with different densities, Ren et al. (2012) and Chen et al. (2013) reported density influence on *Larix principis rupprechtii* forest soil and soil moisture of oak mixed forests, respectively. *Leucaena leucocephala* come from Central America is a small tree or shrub. Knowledge of the density effect on soil of *L. leucocephala* stands is lacking. The aim of this study was to study differences in soil biochemical property among different density stands.

---

*The Study was Partially Supported by Foundation of Guangdong Forestry Department, China (No. 4400-F15050)

*Corresponding author, E-mail: forxue@scau.edu.cn*
2. MATERIALS AND METHODS

2.1 Experimental forest survey

The experiment field site was located in Yuejin nursery of South China Agricultural University, Guangzhou City, South China (113°21'E, 23°09'N). The nursery has subtropical monsoon climate with a characteristics of warm, rainy, and ample light. The annual average temperature, the coldest month (January), and the hottest month (August) temperatures were 21.8, 13.3 and 28.1°C, respectively. Average Annual rainfall and annual relative humidity were 1714.4 mm and 79%, respectively. Nursery soil is exotic soil.

2.2 Research methods

In July 2011, L. leucocephala seedlings with the average diameter at breast height of 0.35 cm and average height of 27 cm were planted by the density of 2, 4 and 8 trees·m², three plots, each of 20 m × 15 m in size, were established in each density stand. Meanwhile a control plot closing the plots was set up.

Soil samples from the 0-40 cm soil layer were taken randomly from 5 different points in each of the plots, and mixed as a composite sample. The analyses of soil chemical properties were followed the methods of Institute of Soil Science, Chinese Academy of Sciences (1978). The pH at each plot was determined using an electrode pH meter. The soil organic matter, total nitrogen (N), total phosphorus (P) and total potassium (K) were analyzed using the potassium dichromate oxidation-outer heating method, semimicro-Kjeldahl Method, molybdenum-blue colorimetric method and flame photometer, respectively. Available N, available P and available K were determined using alkali N-proliferation method, molybdenum-blue colorimetric method and flame photometer, respectively. The activities of urease, phosphatase and catalase were estimated by colorimetric method, disodium phenyl phosphate colorimetric method and titration method of KMnO4, respectively.

All statistical analyses were performed using Excel 2003 and the Statistical Analysis System (SAS 9.0). Tukey’s test to test the significant difference between soils of different density stands. Differences were considered significant at the P < 0.05 level.

3. RESULTS

The soil pH of the three density stands was significantly lower than the control (P<0.05) (Figure. 1). The soil organic matter in 8 trees m² stand was significantly higher than the control (P<0.05).
The total N content in the three density stands was significantly higher than the control (P<0.05), whereas the contents of total P and available K were significantly lower than the controls (P<0.05). The soil total K in 4 and 8 trees·m² stands were significantly lower than the control (P<0.05), whereas their available N was significantly higher than the control. The content of soil available P in 2 trees·m² stand was significantly higher than the control (P<0.05).

The same letter indicates that the difference is not significant (P<0.05).

Figure 1. Soil chemical properties (mean±SD)ck, control; I, 2 trees·m²; II, 4 trees·m²; III, 8 trees·m² a, b and c are the results of multiple comparisons.
The same letter indicates that the difference is not significant  \( P<0.05 \)

Figure 2. Soil enzyme activities (mean±SD) ck, control; I, 2 trees·m\(^{-2}\); II, 4 trees·m\(^{-2}\); III, 8 trees·m\(^{-2}\) a, b and c are the results of multiple comparisons.

Urease activity in 4 and 8 trees·m\(^{-2}\) stands was significantly higher than the control and 2 trees·m\(^{-2}\) stand (\( P<0.05 \)) (Figure 2). Phosphatase activity in 2 trees·m\(^{-2}\) stand was significantly higher than the control (\( P<0.05 \)), whereas 4 and 8 trees·m\(^{-2}\) stands were significantly lower than the control (\( P<0.05 \)). Catalase activity in the three density stands was significantly lower than the control (\( P<0.05 \)).

4. DISCUSSION

Litter increased due to planting, and a large amount of acid produced during litter decomposition, which caused soil pH to decrease (Zhou et al., 2004). As L. leucocephala belongs to the family of Mimosaceae, its rhizobium can directly fix nitrogen from the atmosphere, thus its soil nitrogen content increased. Soil organic matter and total N content were closely related, so that organic matter content increased significantly in high-density L. leucocephala stands. The decrease in total P in all density stands may be that fast growth L. leucocephala trees absorbed massive P. The available P content in L. leucocephala soil was higher than the control, which may be related to the soil Phosphate-solubilizing microorganisms (Zhang et al., 2015). Phosphate-solubilizing microorganisms can decompose difficulty soluble mineral phosphate and organic phosphorus compounds and release available phosphorus in soils (Wang et al., 2009). The 4 and 8 trees·m\(^{-2}\) stands had a high N content, so that urease activity increased, which promotes the hydrolysis of peptide bond in organic molecules and causes available N content to increase. The 4 trees·m\(^{-2}\) stand increased phosphatase activity, speeding up the circulation of organic phosphorus to accelerate, consequently increasing available phosphorus content (Xue et al., 2005). On the other hand, soil K content decreased due to the rapid growth of L. leucocephala trees. Guangzhou is located in South Asia tropics
associated with heavy rainfalls. Catalase activity decreased in all density stands, weakening cellulose decomposition intensity, which is not favorable to carbon cycle and the synthesis of soil humus and affects the accumulation of soil organic matter.

REFERENCES


