SOIL RESISTANCE TO ROOT PENETRATION IN DIFFERENT COFFEE AGRO-ECOLOGICAL MANAGEMENT SYSTEMS

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Abstract

Most coffee farmers in Espírito Santo have plantations managed with the conventional system. This system is characterized by deforestation of native areas and the indiscriminate use of agrochemical inputs that compromise the physical, chemical and biological quality of the soil. In contrast to the conventional system, the agro-ecological management system (AMS) contributes to the sustainability of ecosystems and improvement of soil attributes. The planting of coffee trees in the SMA is considered a sustainable alternative for agricultural production, providing extra income for farmers and reducing their production costs. The objective of this work was to evaluate the soil mechanical resistance to root penetration (RP) of arabica coffee plants (Coffea arabica L.) in plantations with SMA management, in relation to the timing since the start of intercropping. The study was carried out on a family farm located in the municipality of Guaçuí-ES. The SMA parameters evaluated were: S1 (Coffea arabica L., Musa sp. and Euterpe edulis) planted 20 years ago; S2 (Coffea arabica L., Musa sp. and Bactris gasipaes Kunth) planted 4 years ago; and S3 (Coffea arabica L. and Musa sp) planted simultaneously 2 years ago. RP was measured under field conditions, in the of 0.0–0.10 m soil layer, using an impact penetrometer. Three replications were carried out at two sampling points, under the projection of the coffee tree canopy (PC) and between the rows (EL) in the three SMA areas. In a reference area, native forest (MNT), RP was measured randomly, in the same soil profile, with three repetitions, totaling 21 repetitions in the entire study area. Mean values of SMA RP were submitted to Dunnett's test at 5% significance. The results showed that MNT had the lowest mean value (1.48 MPa). The mean values of SMA S1 (PC and EL) were statistically equal to the values displayed by the MNT. The reduction in the value of RP in this system may have been due to the minimum mobilization of the soil, the high and constant input of organic matter from the pruning of coffee trees and plants intercropped for 20 years. It is worth mentioning that this area was never used for cattle breeding. The absence of trampling contributed to the maintenance of the physical quality of the soil. The highest mean values were obtained for S2 (PC) and S3 (PC and EL): 4.98, 4.50 and 4.08 MPa, respectively, with significance of $p<0.001$, evidencing a difference in relation to the results obtained for MNT. The highest RP values observed for the SMA with least implementation time can be attributed to the intense land uses as pasture, with cattle trampling, and coffee monoculture, causing an increase in RP over the years. The SMA S2 (EL) obtained an average value of 3.23 MPa with $p<0.01$, contrasting with the lowest value of MNT. Between the rows of this system, corn (Zea mays) and jack bean (Canavalia ensiformis) are planted, which may have promoted the beginning of RP improvement during the years of SMA implementation. Soil resistance to root penetration was affected by long years of conventional management of coffee plantations and cattle grazing. Results showed that S2 and S3 are still under negative influence in relation to the RP due to the management history. The implementation time of these SMA areas was still not enough to promote significant improvements. On the other hand, the longer time of implantation of the SMA (S1) had a positive influence in reducing the resistance to penetration of the roots in the soil, favoring the growth and development of the root system, with positive reflections on the sustainability of the agro-ecosystems and the soil conservation.

Keywords

Agro-ecological Soil Management, Soil Compaction , Coffee.