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Effects of the legume Vigna unguiculata crop on carbon and nitrogen cycles

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In this study, we investigated the effects of a legume crop (Vigna unguiculata) on soil properties related to the carbon (C) and nitrogen (N) cycles, taking into account different management practices (conventional and organic) and two genotypes. The study was randomly designed in blocks with four replications, in plots of 10 m2. The crop cycle spanned from 29 May 2014 to 13 August 2014. We collected soil samples (0-30 cm) from each plot at the beginning and at the end of the cycle to measure soil total N, organic C, recalcitrant C, organic C labile fractions, microbial biomass C (MBC) and the enzyme activities β-glucosidase and β-glucosaminidase. We collected plant samples (seeds, pods, roots and stem/leaves) at two different maturity stages (fresh and dry pods) to assess the influence of management practices and genotype in the accumulation of N, as indicative of the content of proteins in the crop. In the final plant sampling, we also determined crop production.
The results showed that no significant differences were observed between management practices and genotypes in any of the soil properties measured. However, total N, recalcitrant C, most labile C fraction, MBC and β-glucosidase increased at the final sampling compared to initial values. We observed that genotype had a significant effect on the concentration of the second fraction of labile C under organic management. N content in the different plant tissues was significantly higher in the intermediate sampling than in the final harvest, without significant differences between management practices and genotypes. We observed a significant positive correlation between N content in roots, seeds and pods. N content was always higher in seeds, indicating the high quantity of proteins in this crop. C content was significantly lower in stem/leaves than in the rest of tissues, without significant differences among them. No effect of management practice, maturity stage or genotype was observed with regard to C in plant. Crop production was significantly different in terms of genotype, with higher values under organic management. We observed that soil total N was significantly correlated with the most labile C fraction, MBC and β-glucosidase activity. Thus, it seems that increments in N concentration in soil are stimulating microbial growth with the release of enzyme activities to degrade organic compounds. As a consequence, the most labile organic fractions are increasing. These results seem to suggest that the cultivation of Vigna unguiculata may increase N content in soil, independently of the management practices tested, and stimulate microbial populations which can release nutrients to soils by degradation of soil organic matter. Despite no great effects of management practice were observed with regard to soil properties, the organic management favored higher crop production, encouraging the adoption of this type of fertilization.
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