Mineral Nitrogen and Microbial Biomass Dynamics under Different Acid Soil Management Practices for Maize Production

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Abstract

Field and laboratory incubation studies were conducted to determine the effect of different acid soil management practices; liming (L), combined N and P fertilizers (NP), and goat manure (M) application, for maize production on the dynamics of mineral N, microbial biomass nitrogen (MBN) and microbial biomass carbon (MBC). A randomized complete block design with a 23 factorial arrangement replicated thrice was used. The factors, each at two levels, were:NP fertilizers applied as triple superphosphate (0 and 75 kg ha-1), and urea (0 and 50 kg ha-1), L (0 and 2.5 t ha-1) and M (0 and 5 t ha-1) giving a total of eight treatments; L, M, NP, LM, LNP, MNP, LMNP and C (control). Soil samples for determination of mineral N, MBC and MBN were collected from the 0-15 and 15-30 cm depths at seedling, tasselling, and maturity stages of maize growth and after 0, 15, 30, 60, 120 and 240 days of laboratory incubation of soils obtained from the same field. The NP treatment had significantly ($P< 0.5$) higher levels of mineral N in both depths at all stages of maize growth, followed by MNP and LMNP. The net mineralized N (μgN/g dry soil) for the incubated soil followed the order LMNP, MNP, LM, M, L, LNP, C and NP for the two depths. The MNP, LMNP and M treatments had significantly higher MBC and MBN for both field and incubated soils. The correlations between mineral N and MBN were positive but non-significant at seedling and maturity stages of maize growth in the 0-15 cm depth and at seedling and tasselling stages in the 15-30 cm depth. The correlations between MBN and Mineral N for both depths and sampling periods were positive and significant for the incubated soils, The maize grain yield increases (%) above control were 43, 36.4, 31.1, 25.3, 21.9, 13.7 and 3.0 for LMNP, MNP, NP, M, LNP, LM and L treatments, respectively. Application of LMNP and MNP treatments enhanced mineral N, MBC and MBN and concomitantly soil quality and productivity as gauged from the improved maize yields in the respective treatments. Combining manure, lime and chemical fertilizers and /or manure and chemical fertilizers is thus a promising alternative to developing a more sustainable acid soil management strategy for increased maize production in Molo district, Kenya.