SOIL MINERAL NITROGEN, YIELDS AND ISOTOPIC COMPOSITION OF MAIZE-COWPEA MBILI SYSTEMS UNDER CONSERVATION AGRICULTURE IN EASTERN KENYA

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Abstract

Providing farmers with access to improved technologies and know how's, is an important component of conservation agriculture (CA) in Kenya. A lack of research on grain legume atmospheric dinitrogen fixation response to no-till practices was identified and investigated upon. The study was performed at the Kiboko research station, located in semi-arid eastern Kenya on research field trails which had been running for 7 seasons by the time the sampling took place during the long rains of 2017. The experimental set up was a randomized complete block design with a split-split-split design, main plots being tillage system (no till with maize stover applied at 5 Mg ha (CA) and conventional tillage (CT) to 15 cm depth without mulch), sub plot being cropping system (maize-cowpea intercrop, maize monocrop and cowpea monocrop) and sub-sub plot maize variety (WE1101, . The natural abundance method was used to assess ^{15}N and ^{13}C partitioning among above and below ground maize and cowpea plant parts, at flowering and harvest stages. Soil mineral nitrogen was more abundant in the top soil decreasing to subsoil (0-5 cm depth > 5-15 > 15-30 > 30-50) although only significant when comparing NH_4^+ content in CA intercrop to CT monocrop cowpea in the top 15 cm. Total soil C and N was not significant among CA and CT treatments across depths which could be attributed to the limited capacity of sandy soils to accumulate OM. Number of nodules per plant was higher in CA treatments rather than CT although not significant ($p>0.05$). At flowering stage, ^{15}N abundance varied between plant parts, with roots and nodules found to be enriched compared to shoots although litterfall also reported higher than shoot values. At harvest ^{15}N values were consistently lower than at flowering as well as the reference plant reporting lower ^{15}N at the second harvest compared to the first. No significant differences were found among whole plant weighted means (between 1.5 and 2.4 at flowering stage and between 0.9 and 2.1 at harvest stage). When comparing cowpea's ^{15}N values to the reference maize, percentage of N derived from fixation (%Ndfa) resulted in being between 56.5 % and 68.8 % at flowering stage and between 44.8 % and 63.6 % at harvest stage. Cowpea in intercrops yielded between 472 and 590 kg ha of grain while in monocrops the seed yield was between 1464 and 1618 kg ha. This meant that intercrops derived between 17.8 and 22.8 kg ha of their total N from atmospheric dinitrogen fixation while monocrops between 54.9 and 55.2 kg ha. Between 200 and 400 kg ha of litterfall were recorded in intercrops while between 1000 and 1200 kg ha^{-1}in monocrops which. Belowground dry weight accumulation was between 7 and 9% of total plant's biomass. 13c data revealed no differences in water stress between CA and CT but the effect was clear ($p<0.001$) between monocrop and intercrop cowpea suggesting $\delta^{13}C$ higher cowpea water stress in intercropped plots. $\delta^{15}N$ ha^{-1}. Overall the thesis suggest that crop rotations may be a more favourable means to increase both N availability and reduce intraspecific competition.