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N_2-Fixation and Water Stress in Beans in Agroforestry or Slash & Mulch Systems in Nicaragua

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Abstract

Drought and soil degradation are challenges for maize and bean agriculture production in Central America. Slash and Burn (S&B) agriculture has led to severe soil degradation and yield reduction with ongoing intensification. Two cropping systems called the Quesungual Slash & Mulch Agroforestry System (QSMAS) as well as a Slash and Mulch cropping system (S&M) were established in La Danta and La Flor in Northwestern Nicaragua, to counteract the soil degradation. The main objectives of this study were to compare water stress and nitrogen fixation capacity of bean plants (*Phaseolus vulgaris* L.) growing in these systems in the year 2015 on six farms. Statistical evaluation was made with a one-factorial ANOVA analyses and linear regressions. Water stress was determined with the ^{13}C isotope discrimination method. Nitrogen fixation was determined with the ^{15}N natural abundance method. The results revealed that under average weather conditions in La Danta, bean plants experienced less water stress in the S&M system. However, during dry conditions neither of the systems had a superior mitigation effect on the water stress. Results also showed that trees in the QSMAS were a direct competitor for the water availability to beans (i.e. negative relationship between bean ^{13}C and tree leave biomass). However, the harvest index was significantly higher in QSMAS. The proportion of N derived from fixation was 38 % (SE 7.0) and 43 % (SE 9.8) for the QSMAS and S&M systems respectively. Nitrogen fixation was relatively low with 7.5 and 6.6 kg N ha^{-1} for the QSMAS and S&M systems respectively, mainly due to the reduced bean growth (e.g. 379 vs 221 kg DM ha^{-1}) associated with water stress during the later growing period.

Keywords: Agroforestry, drought, N fixation, stable isotopes

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