Abstract

Soil fertility decline is one of the major constraints in agricultural productivity in Africa. Biological nitrogen fixation (BNF) in green - grams can offer a cost effective and sustainable means towards soil fertility management. Green-gram, a drought tolerant legume, constitutes an important grain legume crop in semi-arid areas of sub Saharan Africa. In Kenya, green-gram is a major source of food security particularly in Tharaka Nithi County. However, green-gram yields are usually low due to low phosphorous and nitrogen levels of the soil. There is limited information on the enhancement of nitrogen fixation efficiency of green - grams through *Rhizobium* inoculation and phosphate rock among farmers' preferred green-gram varieties (N26 - nylon and KS20 - uncle). Therefore, the aim of this study was to determine the effect of *Rhizobium* inoculation and phosphate rock fertilizer on green-grams performance and soil chemical variables. The study was carried out at Chuka university horticultural research farm for two cultivations; November 2019 - January 2020 and February - April 2020. A factorial experiment of 2 x 2 x 2 was laid out in a randomized complete block design. There were three factors, varieties (26 - nylon and KS20 - uncle), phosphate rock (0 and 30 kg P ha-1) and *Rhizobium MEA* 716 (0 and 100 g ha-1) making a total of eight treatments which were replicated three times. Soil sampling and analyses were done for soil pH, fixed − N and total nitrogen (TN), available Phosphorous, total organic carbon (TOC), fixed − N and potassium before planting and after harvesting of green-grams. Data on growth and yield variables were collected fortnightly on four randomly selected plants on plant height, number of leaves branches, pods, nodules, effective nodules, nodule dry weight, grain yield, total dry biomass, shoot and root dry weights. Nutrient uptake was done for N and P also phosphorus use efficiency (PUE) and nitrogen use efficiency (NUE) were done. Data was analysed using Statistical Analysis Software (SAS). Significant means were separated using Least Significant Difference (LSD) at probability level of 5 %. Results for both cultivations indicated that treatment R1P1V2 showed significantly (P<0.05) higher increase in soil pH (7.54), TN (0.58%), TOC (3.45%), P (68.20 ppm), EC (0.95 Cmolkg-1), K (1.75 Cmolkg-1) and fixed-N (0.50%) over other treatments. Similarly treatment R1P1V2 had significant (P<0.05) increase in number of nodules (101.78 plant-1), effective nodules (9.92 plant-1) and nodule dry weight (3.81g plant-1), these trends were observed in N and P use efficiency and their uptake compared to other treatments. On growth variables treatment R1P1V2 recorded significantly (P<0.05) higher plant height (76.07 cm), number of branches (14.08 plant-1), shoot dry biomass (52.01 g plant-1), root dry biomass (7.60 g plant-1), total dry biomass (146.4 g plant-1), number of pods (84 plant-1) and yield (2158 kg ha-1). Therefore, combination of *Rhizobium* MEA 716 100 g ha-1 with phosphate rock 30 Kg ha-1 in variety KS20 improved soil chemical properties, enhanced nitrogen fixation ability and equally growth and yield of green-grams. Based on the findings, combining *Rhizobium* MEA716 100 g ha-1, and 30 Kg ha -1 phosphate rock with variety KS20 was recommended for a sustainable green-gram production and soil fertility management in Chuka area - Tharaka Nithi County.