Influence of Soil and Fertilizer Nutrients on Sustainability of Rainfed Finger Millet Yield and Soil Fertility in Semi-arid Alfisols

Abstract

Productivity of rainfed finger millet in semiarid tropical Alfisols is predominantly constrained by erratic rainfall, limited soil moisture, low soil fertility, and less fertilizer use by the poor farmers. In order to identify the efficient nutrient use treatment for ensuring higher yield, higher sustainability, and improved soil fertility, long term field experiments were conducted during 1984 to 2008 in a permanent site under rainfed semi-arid tropical Alfisol at Bangalore in Southern India. The experiment had two blocks—Farm Yard Manure (FYM) and Maize Residue (MR) with 5 fertilizer treatments, namely: control, FYM at 10 t ha^{-1}, FYM at 10 t ha^{-1} + 50% NPK [nitrogen (N), phosphorus (P), potassium (K)], FYM at 10 t ha^{-1} + 100% NPK (50 kg N + 50 kg P + 25 kg K ha^{-1}) and 100% NPK in FYM block; and control, MR at 5 t ha^{-1}, MR at 5 t ha^{-1} + 50% NPK, MR at 5 t ha^{-1} + 100% NPK and 100% NPK in MR block. The treatments differed significantly from each other at $p < 0.01$ level of probability in influencing finger millet grain yield, soil N, P, and K in different years. Application of FYM at 10 t ha^{-1} + 100% NPK gave a significantly higher yield ranging from 1821 to 4552 kg ha^{-1} with a mean of 3167 kg ha^{-1} and variation of 22.7%, while application of maize residue at 5 t ha^{-1} + 100% NPK gave a yield of 593 to 4591 kg ha^{-1} with a mean of 2518 kg ha^{-1} and variation of 39.3% over years. In FYM block, FYM at 10 t ha^{-1} + 100% NPK gave a significantly higher organic carbon (0.45%), available N (204 kg ha^{-1}), available P (68.6 kg ha^{-1}), and available K (107 kg ha^{-1}) over years. In maize residue block, application of MR at 5 t ha^{-1} + 100% NPK gave a significantly higher organic carbon (0.39%), available soil N (190 kg ha^{-1}), available soil P (47.5 kg ha^{-1}), and available soil K (86 kg ha^{-1}). The regression model (1) of yield as a function of seasonal rainfall, organic carbon, and soil P and K nutrients gave a predictability in the range of 0.19 under FYM at 10 t ha^{-1} to 0.51 under 100% NPK in FYM block compared to 0.30 under 100% NPK to 0.67 under MR at 5 t ha^{-1} application in MR block. The regression model (2) of yield as a function of seasonal rainfall, soil N, P, and K nutrients gave a predictability in the range of 0.11 under FYM at 10 t ha^{-1} to 0.52 under 100% NPK in FYM block compared to 0.18 under MR at 5 t ha^{-1} + 50% NPK to 0.60 under MR at 5 t ha^{-1} application in MR block. An assessment of yield sustainability under different crop seasonal rainfall situations indicated that FYM at 10 t ha^{-1} + 100% NPK was efficient in FYM block with a maximum Sustainability Yield

Index (SYI) of 41.4% in <500 mm, 64.7% in 500–750 mm, 60.2% in 750–1000 mm and 60.4% in 1000–1250 mm rainfall, while MR at 5 t ha^{-1} + 100% NPK was efficient with SYI of 29.6% in <500 mm, 50.2% in 500–750 mm, 40.6% in 750–1000 mm, and 39.7% in 1000–1250 mm rainfall in semi-arid Alfisols. Thus, the results obtained from these long term studies incurring huge expenditure provide very good conjunctive nutrient use options with good conformity for different rainfall situations of rainfed semiarid tropical Alfisol soils for ensuring higher finger millet yield, maintaining higher SYI, and maintaining improved soil fertility.

Keywords: Crop seasonal rainfall, crop yield sustainability, regression analysis, semi-arid Alfisols, soil fertility, sustainability yield index