

Optimizing Smallholder Returns to Fertilizer Use: Bean, Soybean and Groundnut

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Abstract

Smallholder African farmers commonly lack the financial means to purchase enough fertilizer for application at the economical optimal rates (EOR), or the rates for maximization of net returns ha^{-1} , to all of their land. Research was conducted for bean (*Phaseolus vulgaris*L.), soybean (*Glycine max*L.) and groundnut (*Arachis hypogaea*L.) to establish a basis for determining the combinations of crops, nutrients, and application rates to optimize net returns to fertilizer use and the benefit:cost ratio (BC) in Uganda. Yield response to nutrient application, EORs, and equations for estimating BC were determined. Eleven to 17 trials were conducted for each crop. Mean yields were increased by 92%, 111%, and 92% for N applied to bean, and P applied to soybean and groundnut, respectively, at $15\text{kg}\text{ha}^{-1}$, with less yield responses for P applied to bean and K applied to soybean and groundnut. Mean yield peaked at 1.81, 1.92, and $1.71\text{Mg}\text{ha}^{-1}$ for bean, soybean, and groundnut, respectively. Mean EOR varied with fertilizer cost relative to grain price (CP) and were $27\text{--}42\text{kg}\text{ha}^{-1}\text{N}$ for bean, and $13\text{--}29\text{kg}\text{ha}^{-1}\text{P}$ with higher rates for groundnut compared with bean. The greatest BC was for N applied to bean followed, in decreasing order, by P applied to soybean or groundnut, P applied to bean, and K applied to groundnut or soybean. Consideration of the six sets of crop–nutrient response functions developed enables optimization of smallholder investment in fertilizer by identifying the crop, nutrient, and application rate combinations that maximize net returns on investments in fertilizer use. This approach is applicable for smallholder crop production globally where farmers cannot purchase enough fertilizer to apply at EOR. We studied fertilizer response for bean, soybean, and groundnut in Uganda. Smallholders often have little money for fertilizer. They need to optimize returns on their small investment. Returns were highest for N applied to bean and P applied to soybean and groundnut. Information is given for selecting crop/nutrient/rate combinations for high net returns. This gave 100% more net return compared with maximizing net returns per hectare. The methodology is adaptable to smallholder farming situations globally.

Key Words: Smallholder Returns, Fertilizer Use, Bean, Soybean, Groundnut