FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Optimizing Fertilizer Application for common bean (*Phaseolus vulgaris, L.*) in Gurúè, northern Mozambique

Ricardo M. Maria
and
Unasse S. Waite

Instituto de Investigacao Agraria de Mocambique

Legume Innovation Lab

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

USAID
FROM THE AMERICAN PEOPLE

Introduction

- Gurúè is one of the major bean producer areas in Mozambique
- Bean is the main source of income and protein of a majority of farmers
- Poor soil fertility, drought, and pests are the main limiting factors to bean production
- Enhancing bean production and productivity through improved soil fertility and water management is essential for improving food security and nutrition

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Research Objectives

- Quantify bean response to applied fertilizer N, P, S in Tetete, Northern Zambezia province
- Determine the economic optimum fertilizer rate application
- Develop a diagnostic tool for supporting farmer decision-making estrategies for improved soil fertility management

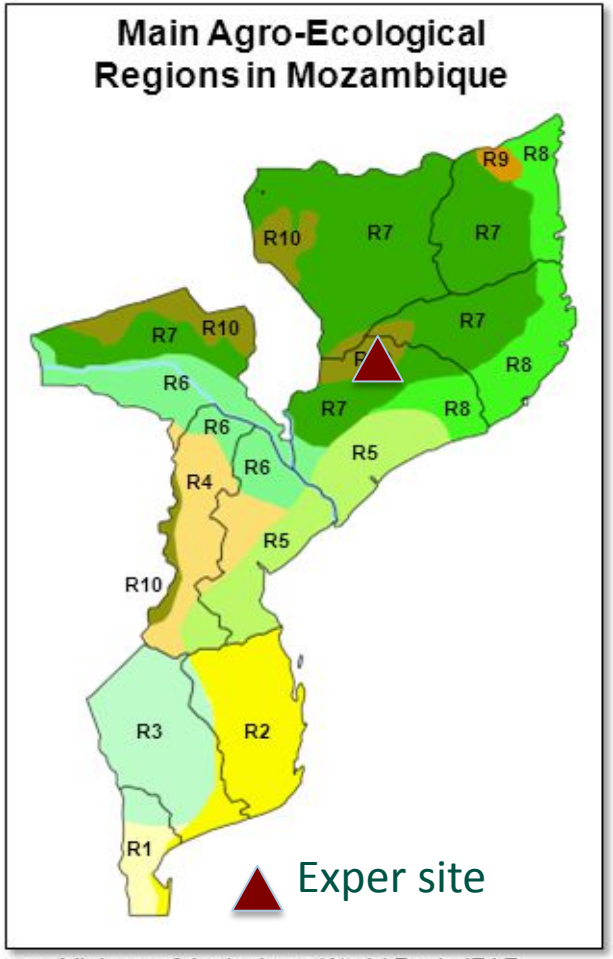
Material and Methods

- The experiment was conducted 2015/16, on-farm in Gurue (R10) at 670 m above sea level (asl).
- A randomized complete block design with three replicates was used.
- The treatment structure was an incomplete factorial arranged as a strip plot with
- 3 N rates (10 -20 -30 Kg ha^{-1}) ,
- 3 N rates (10 -20 -30 Kg ha^{-1}) at 15 Kg P ha^{-1}.

Material and Methods (cont…)

- 3 P rates (7 -15 -22.5 Kg ha^{-1}) at fixed 20 Kg N ha and
- 3 S rate (5 – 10 – 15 Kg ha^{-1}) at fixed N and P rates (20 and 15 Kg ha^{-1}).
- Two improved bean varieties (NUA 45 and VTTT) were used
- Soil samples were collected by replicate from 0 – 20 cm and analyzed with wet chemistry at IIAM central soil and plant tissue testing facility
- Agronomic and climate were collected

Agricultural commodity by Region



Source: Ministry of Agriculture; World Bank, IFAD

Region	Part of Mozambique	Ag. Commodities Produced
R1	Inland Maputo and south Gaza	Maize, cowpea, groundnut, cassava, sweet potato, banana
R2	Coastal region south of the Sabi (Save) River	Maize, sugar, cowpea, sweet potato, groundnut, cassava
R3	Center and north of Gaza, and west Inhambane	Cattle, goats, rice
R4	Medium altitudes of central Maputo	Maize, sorghum, cassava, cowpea
R5	Low altitudes of Sofala and Zambezia	Rice, cotton, cashew
R6	Semi-arid region of Zambezi Valley and Southern Tete	Sorghum, millet, sugar, rice
R7	Medium altitudes of Zambezia, Nampula, Tete, Niassa, and Cabo Delgado	Maize, soybean, sorghum, cassava, cowpeas, groundnuts, rice, sesame
R8	Coastal litoral of Zambezia, Niassa, and Manica	Banana, cassava, millet, rice, cashew
R9	North interior of Cabo Delgado	Maize, sorghum, cowpeas, cassava, sesame
R10	High altitudes of Zambezia, Niassa, and Manica	Soybean, maize, common beans, potatoes, rice

Statistical analyses

- A linear model was used with site, replicate and treatment as fixed effect variables
- Response curves were developed where significant using non-linear plateau model:
- Yield (Kg ha^{-1}) = $a - bc^N$, where a was yield at the plateau or maximum yield, b was the gain in yield due to nutrient application, and c^N determined the shape of the quadratic response where c was a curvature coefficient and N was the nutrient rate.
- Agronomic nutriente use efficiency was calculated
- Economic Optinium Fertilizer use was estimated

Results

- Biomass yield ranged from 463 Kg ha^{-1} and 760 Kg ha^{-1}
- There were statistically significant differences in biomass yield between varieties and among treatments.
- NUA 45 biomass yield was statistically high than VTTT variety.
- Control treatment (No fertilizer added) had the lowest biomass yield and treatment 9 (20 Kg P ha^{-1} and 7.5 Kg P ha^{-1}) had the highest biomass yield (760 Kg ha^{-1})
- Grain yield

Results (cont…)

- Grain yield differ significantly among treatments. The highest grain yield (1351,7 Kg ha^{-1}) was observed in treatment 11 that received (20 – 15 - 5 Kg ha^{-1} of N:P:S) and the lowest yield was observed in treatment that received 10 N with 15 Kg P ha^{-1} (688,3 Kg ha^{-1})

Response Curves

- There was a statistically significant response to applied N rates

Coefficients

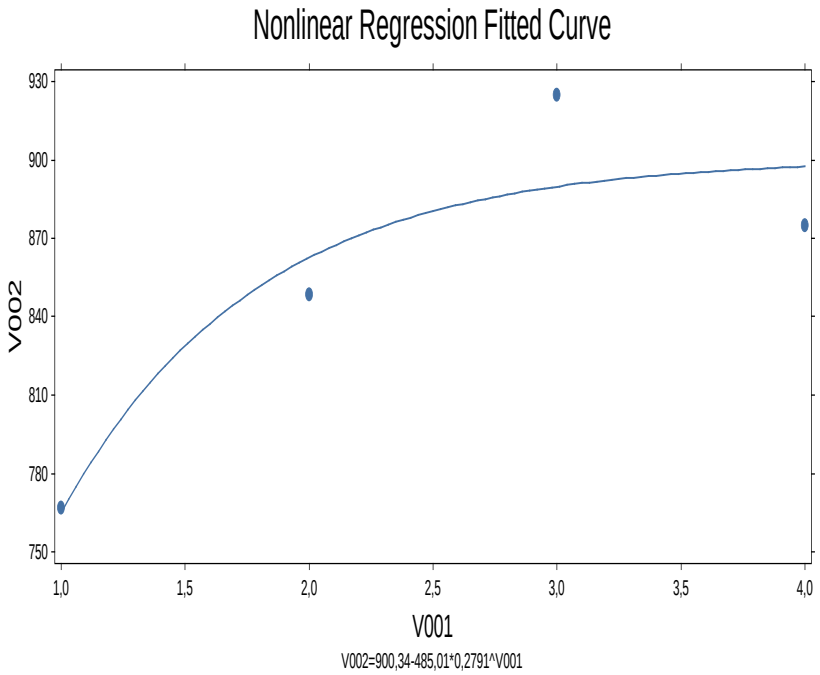
a = 485.3

b= 485.0

c= 0.279

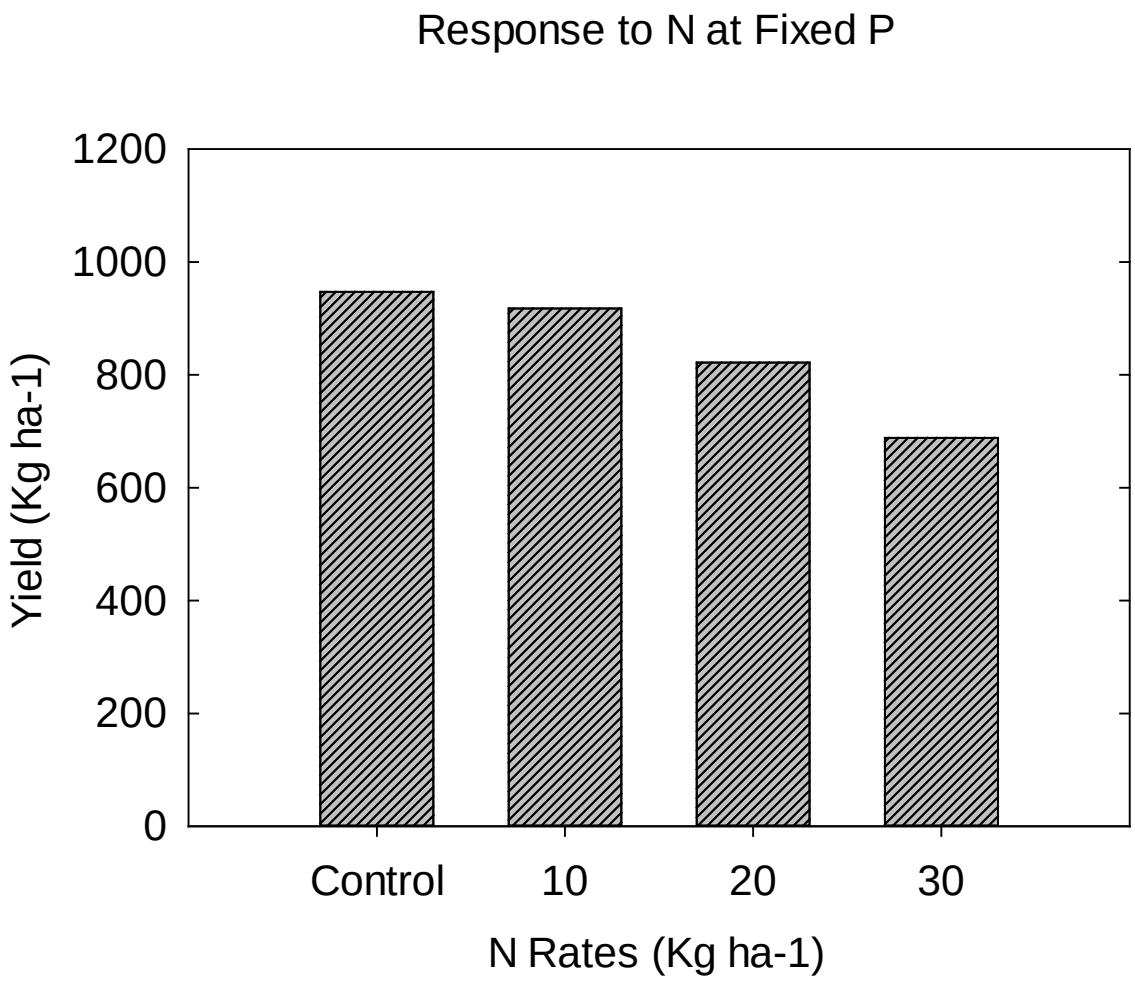
Y = a-b*c^N

R^2 = 0,8529



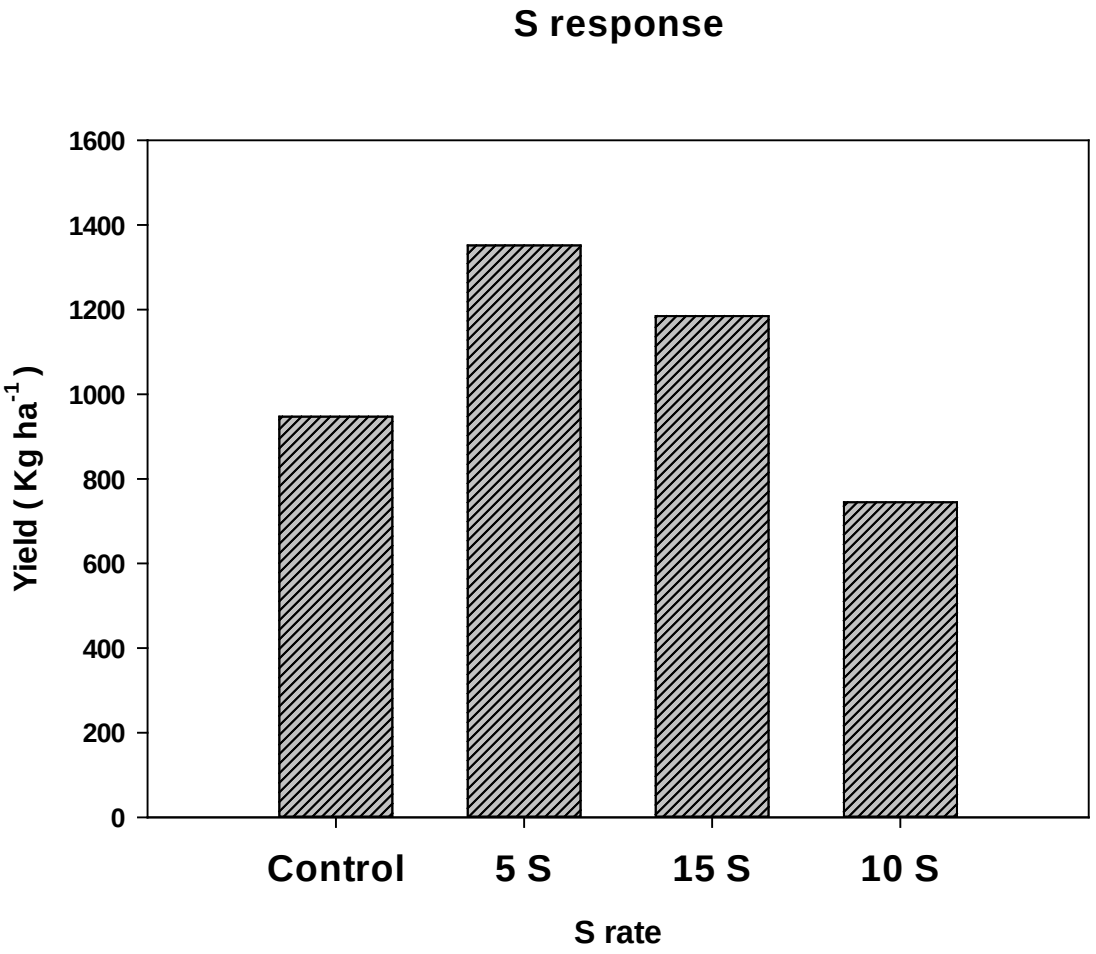
Bean response to N at 15 P

We did not find statistically significant response to N when P was applied.



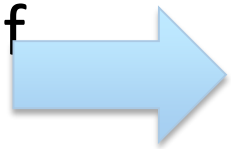
Bean Response to S at fixed NP

There is an increase of yield when S is combined with S.



Discussion

- Soils appeared to be more responsive to applied N which suggests that these soils are more deficient on N
- Sulphur as a nutrient appears to have additive effect when applied together with N and P
- Adding S might increase bean nutritional value
- Fertilizer use efficiency could be higher if combined with water management



Conclusions

- Small amounts of N fertilizer applied at planting can increase bean yield
- N application increased plant growth
- Subsequent crop had good growth with good capacity for soil N uptake and biological N fixation

Acknowledgemt

USAID

Iowa State University

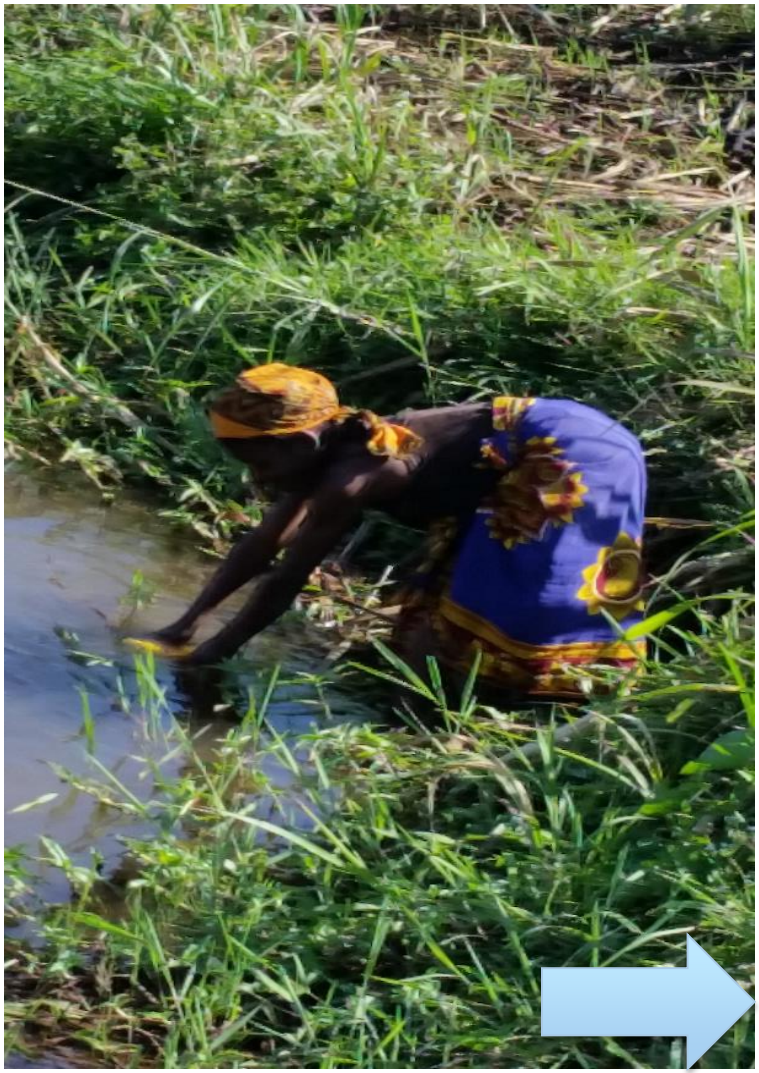
Michigan State University

University of Hawaii

Thank You for your attention !

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes



FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes