ABSTRACT: 354

INTERACTIVE EFFECT OF N, P AND INOCULATION ON GROWTH, NODULATION, N_2 FIXATION AND YIELD COMPONENTS OF PROMISCUOUS AND NON-PROMISCUOUS SOYBEAN (*Glycine max* (L.) MERR.) GENOTYPES

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Soybean (*Glycine max* (L) Merrill) has recently been introduced in Mozambique and is a relatively new crop in the country.Its demand is already high due to the growing livestock and food industry. Soybean yields in Mozambique are generally poor, mainly because of lack of improved varieties, poor cultural practices, and low use or lack of inoculants and chemical fertilizers. Improving its yield therefore will require access and use of inoculation and/or, P and N application. This study evaluated plant growth, nodulation and grain yield of two soybean genotypes in response to N, P and inoculant (I) application under field conditions at Ruace, Mozambique in 2010. The experiment was laid out as a randomized complete design with four replications. Granular inoculation (*Bradyrhizobium japonicum)*, @ 40 kg N ha^{-1} and 40 kg P ha^{-1} were applied at planting, with two varieties, i.e., Storm (non-promiscuous) and TGx-1940-6F (promiscuous). Nodules were sampled at 50% flowering whereas the other plant parts were harvested at maturity. The data revealed marked differences in nodulation, plant growth and grain yield between the soybean varieties, P and N levels and inoculations. The variety Storm, exhibited significantly greater nodulation and grain yield compared to TGx-1904-6F. However, variety TGx-1904-6F produced plants with relatively higher shoot biomass. Application of 40 kg P ha^{-1} resulted in increased nodule number, shoot biomass and grain yield whereas N, I and N+I treatments also resulted in improved nodule numbers, plant growth and grain yield. The results suggest that application of N, I and P can increase grain yield of soybean genotypes in Mozambique.

Effect of N, P application and rhizobia inoculation on growth, nodulation, N_2-fixation, and yield of soybean (*Glycine max* (L.) Merr.) genotypes

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Background

- Soybean (*Glycine max* (L) Merrill), is an important crop at the global level due to its countless and varied uses.

- Grown in Mozambique primarily for cash and human consumption.

Soybean by-products prepared and consumed at community level

Background cont…..

- Soybean is extensively grown in Mozambique, but production is low due in part to lack of improved varieties, and poor crop management practices.

- Soybean has ability to form symbiosis with different soil rhizobia strains, but in Mozambique they occur in few numbers.

- Seed inoculation with rhizobia can increase bacterial population in the soil thus, enhance Biological N_2-fixation (BNF), (Peoples *et al*., 1995)

Background cont….

- Recent studies have shown that moderate application of starter N and moderate amount of P can improve growth and N_2-fixation by soybean (Ray *et al*., 2006)

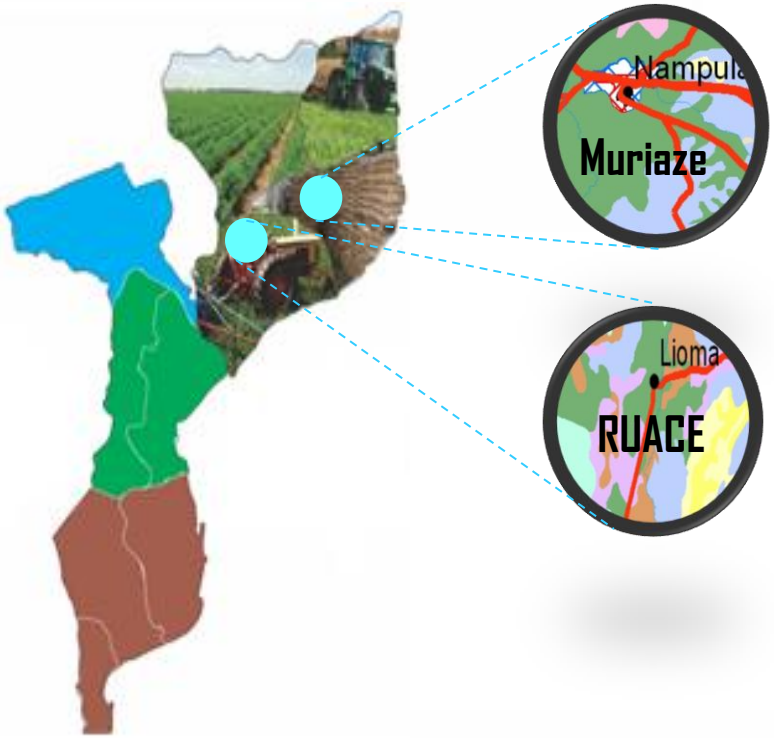
- Limited studies have evaluated an interactive effect of N, P and Rhizobia inoculation under Mozambique conditions

Objectives

- To evaluate the effect of inoculation, starter N and P on nodulation and nitrogen fixation by promiscuous and non-promiscuous soybean genotypes.

- To determine the effect of inoculation, starter N and P on the grain yield of promiscuous and non-promiscuous soybean genotypes

Location of experimental sites



Location	Climate and soil properties							
	Soil	Rain fall	Temp (°C)	pH (H_2O)	Org. C (mg/kg)	N-NO3 (mg/kg)	P (mg/kg)	K (mg/kg)
Ruace	Clay loam	2000	21.00	6.25	2.25	18.62	19.70	123.63
Muriaze	Sand loam	1000	28.00	6.63	1.76	11.18	3.42	113.25

Methodology

Experimental design

- A split-plot design
  - ✓ Storm and TGx 1904-6F
  - ✓ P and N, applied (0, 40 kg/ha)
  - ✓ Soil-applied with granular *Bradyrhizobium* inoculant (strain USDA 61A101)
  - ✓ Experiment was replicated 4 times per site

Methodology

Data gathering

- At flowering stage (R_3)
  - ✓ nodules for bacterial isolation
  - ✓ Shoot for above ground biomass and N accumulation
- At harvesting, plant height, pods/plant, seeds/pod, 100 seed weight and yield/ha were determined

Methodology

Data analyzed using SAS version 9.2 Proc GLM

- One, two and three way Analysis of variance (ANOVA) performed,

- Duncan Multiple Range Test (DMRT) at 5 % probability level

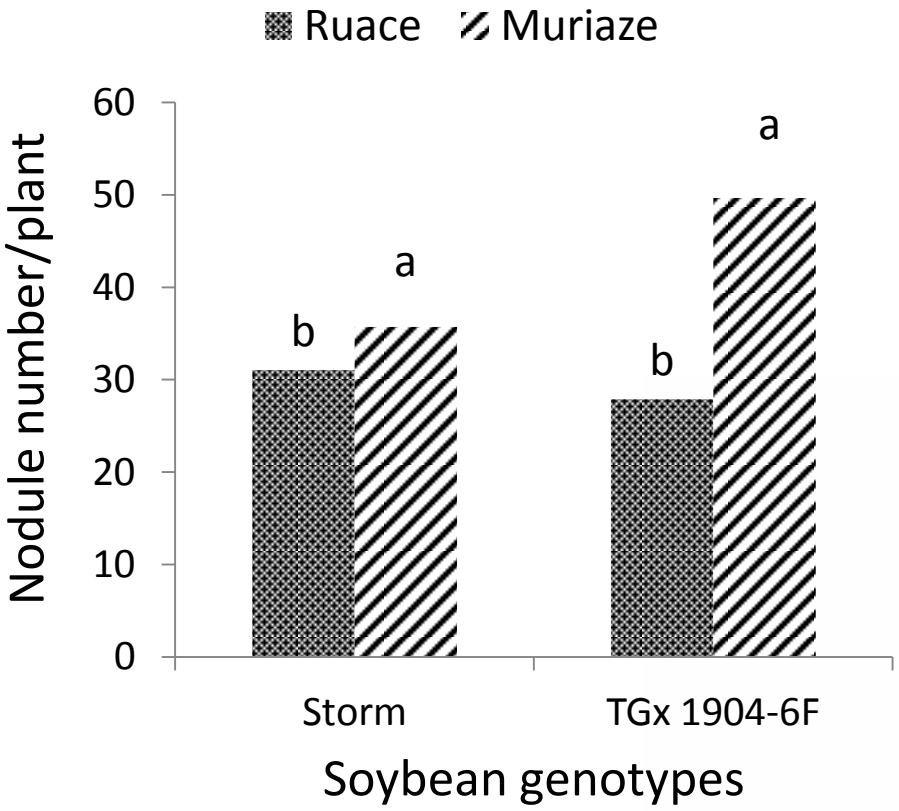
Results

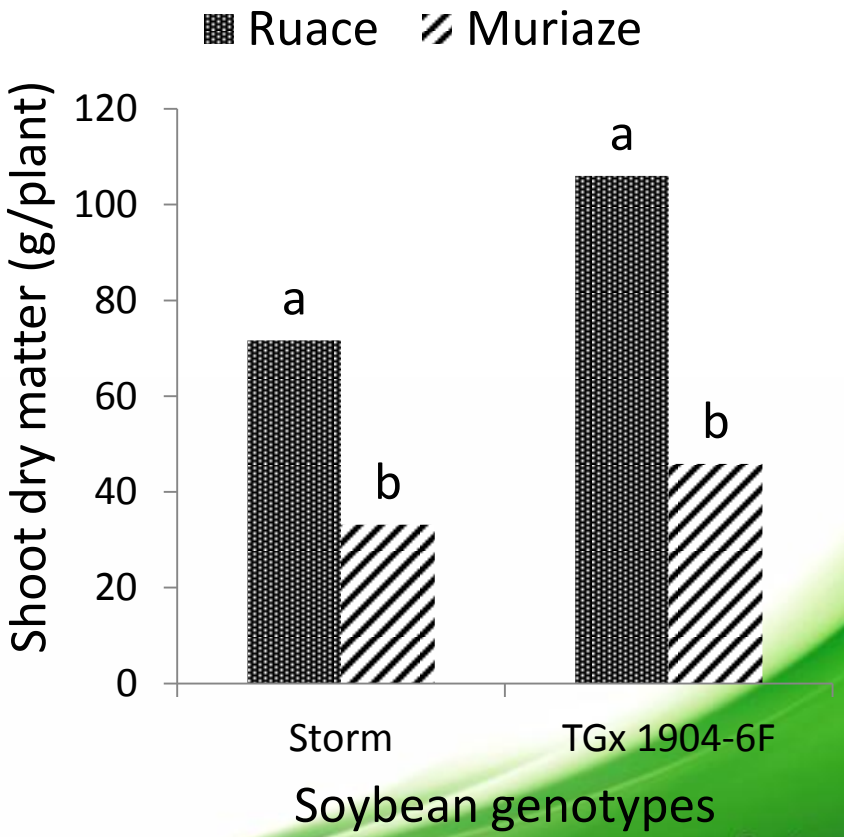
	NOD no/plant	SDM g/plant	Yield (kg/ha)
Locations			
Ruace	29.27b	89.83a	3660.60a
Muriaze	42.69a	39.51b	2454.37b
Genotypes			
Storm	22.82b	52.41b	2894.17b
TGx 1904-6F	29.33a	75.93a	3220.80a
P levels			
P_0 (0 kg/ha)	23.48b	60.79b	2858.19b
P_1 (40 kg/ha)	28.67a	67.55a	3256.79a
Treatments			
Control	16.68c	57.65c	2674.34c
Nitrogen (40 kg/ha)	14.55d	57.67c	2995.73b
Inoculation	35.65a	67.56b	3329.73a
Inoculation + nitrogen	32.42b	73.82a	3330.15a
3-Way ANOVA (F-Statistics)			
Location	3866.4***	4876.9***	3016.2***
Genotype	148.3***	1110.2***	221.2***
P Level	94.2***	91.5***	329.4***
Treatments	306.8***	126.5***	266.5***
Location x Genotype	193.9***	234.7***	51.7***
Location x Treatment	120.7***	17.5***	47.7***
Loc x Plevel x Trea	2.4ns	1.26ns	13.7***
Gen x Plev x Treat	6.32***	6.15***	4.9**

Table 1. Shows the Significant effects of the parameters and their interaction

Results

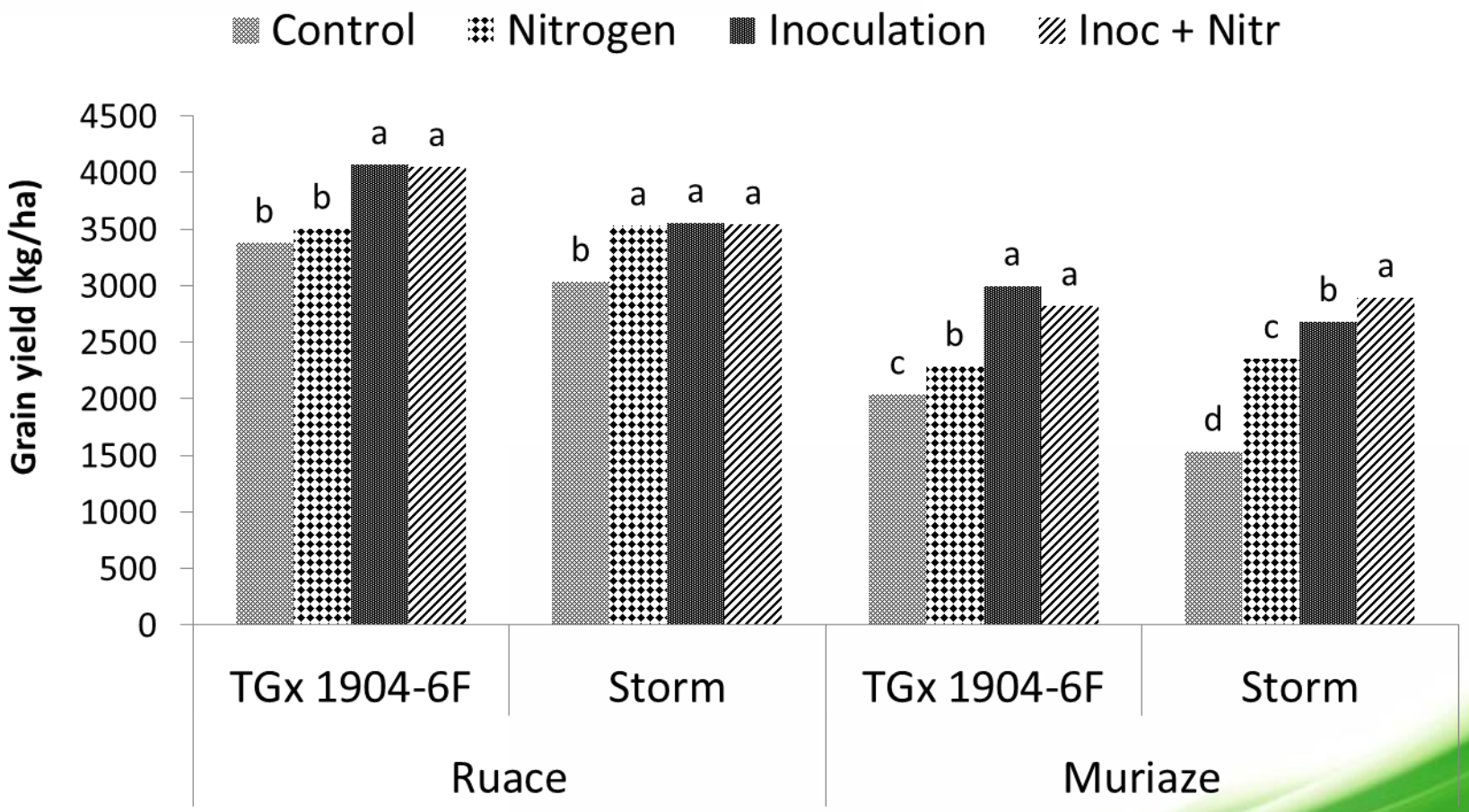
Interactive effect of location and soybean genotypes on nodule number and shoot dry matter. Vertical bars compare nodule number and shoot dry matter between the two genotypes at P<0.05.





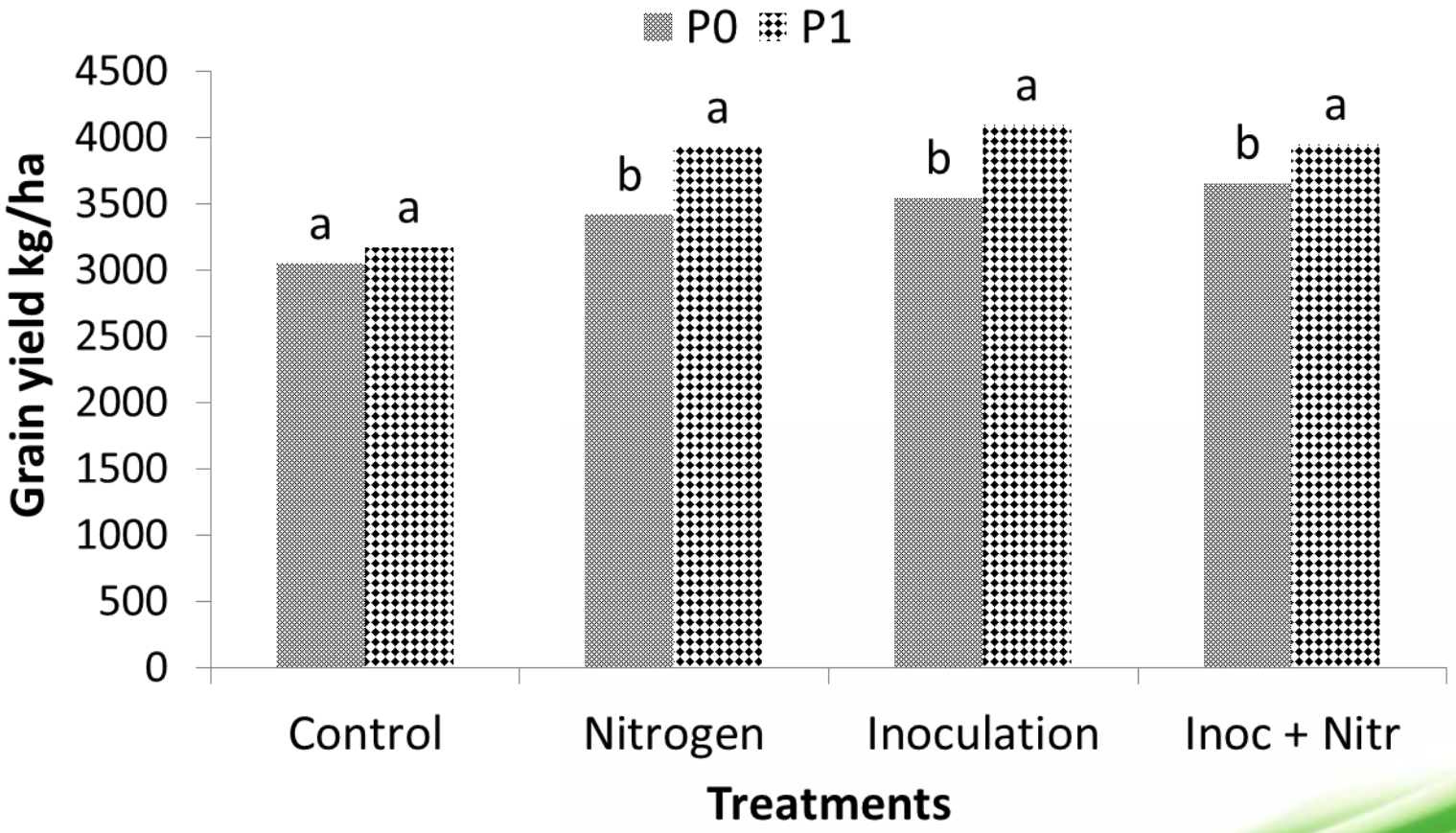
Results

Interactive effect of location, soybean genotypes and treatments on grain yield. Vertical bars compare treatments at P<0.05.



Results

Interactive effect of P application and treatments on grain yield. Vertical bars compare treatments at P<0.05.



Summary

Most parameters showed significant differences ($p<0.05$) between interactions of N, P, and inoculation.

Nodulation was high at Muriaze compared to Ruace, whilst at Ruace, genotypes produced higher shoot dry matter and grain yield.

P application increased nodule number, shoot dry matter and grain yield ha^{-1} and I and N+I significantly improved nodule numbers, grain yield but application of N alone reduced nodule numbers.

Conclusions

- The application of P, I and N+I increased nodulation, shoot dry matter and grain yield in both genotypes across locations.
- Genotype TGx 1904-6F was the best in both locations in terms of nodule number, shoot dry matter and grain yield
- The results suggest that the application of N (in N depleted soil), I and P can increase grain yield of soybean in Mozambique.

Acknowledgement

Thank you