



HIGHLIGHTS OF SOYBEAN TRIALS IN NAMPULA, MOZAMBIQUE, IN THE 2013/14 CROP SEASON

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Summary

Either the expansion of the soybean crop, in small areas or in commercial scale is an option to support the development of the Nacala Corridor region and to promote the betterment of the protein nutrition of its population. This research aimed to identify the best planting times and the most adapted cultivars, and also to study P₂O₅ rates in corrective and maintenance fertilizations, necessary to render soybean high yields in the region. Thus, various field experiments were carried out in Muriaze, located 21 km away from Nacala, Mozambique. Many difficulties in conducting the experiments rendered data, which do not fulfill the ANOVA assumptions, or were highly variable, besides a large number of missing plots, for this reason we advise caution in using and interpreting these data.

Resumo

A expansão de cultivos de soja, tanto em pequenas áreas como em escala comercial, é uma alternativa para alavancar a melhoria da alimentação proteica da população e o desenvolvimento econômico do Corredor de Nacala, MZ. O presente trabalho objetivou identificar a melhor data de semeadura e cultivares adaptadas, além de estudar doses de P₂O₅ e K₂O, em adubações de correção e de manutenção, necessárias para a produção de altos rendimentos da soja na região. Assim, foram

realizados vários ensaios a campo, na localidade de Muriaze, a 21 km de Nacala. As dificuldades na condução dos ensaios geraram muitos dados que não atenderam às premissas da ANOVA ou tiveram grande variabilidade, além de grande número de parcelas perdidas. Por isso, os resultados aqui descritos devem ser vistos com reservas.

Introduction

Soybean is a legume, which grows in tropical, subtropical, and temperate climates. Its domestication took place a long time ago (ca.11th century BC) in China. Chinese traders traveling along the east coast of Africa probably introduced soybean into Africa in the 19th century. The approximate soybean composition is over 36% protein, 30% carbohydrates, and adequate amounts of minerals, vitamins and dietary fibers. It has 20% of oil, making it one of the most important crop for producing edible oil in the world. In Africa, animal protein is scarce and very expensive for most people. Malnutrition is prevalent in many African countries or regions, particularly caused by protein deficiency. Many leguminous crops are able to provide at least part of the badly needed protein, but no one compares to soybean, which nowadays is the only available crop producing an inexpensive and high quality protein comparable to poultry, eggs and meat. (IITA, 2015). Due to its high quality/low price protein, soybean is also the main source of protein supplement for animal feed around the world. Another important characteristic of soybean is its capacity to fix Nitrogen directly from the air, through the symbiosis with Rhizobia. This is of paramount importance in places where fertilizers are expensive and hardly available to farmers. African farming systems, where soils have become exhausted by the need to produce more food for increasing populations, are the ones to benefit most from the soybean Nitrogen biological fixation (NBF) (IITA, 2015). In the African continent, large farm commercial soybean production is still restricted and is located mainly in Zambia, Zimbabwe and South Africa. Soybean acreage is steadily growing in Mozambique and one can foresee the country as an important soybean producer in Africa. Locally generated information is of paramount importance to support the development of economically and environmentally sustainable soybean crop in Mozambique. This research had the objective of providing basic information on several aspects such as planting dates, adapted cultivars and rates of P_2O_5 and K_2O , in corrective and maintenance fertilizations, necessary to render soybean high yields in the region.

Material and Methods

The experiments were conducted at the Experimental Station belonging to the Centro Zonal Nordeste, Instituto de Investigação Agrícola de Moçambique – IIAM, in Muriaze, at 21 km away from Nacala in sandy soils with 90 g/dm^3 , 10 g/dm^3 , and pH 6.0 in water, in the Province of Nacala. The experiments were: production system models; phosphate fertilization (rates and application mode); planting dates and cultivars; and P_2O_5 and K_2O fertilization. In the production systems models, in randomized complete block design and 4 replications, the treatments (crop rotation/succession) will be established along the years. In this season (2013/2014), all its plots were planted with the initial crop (soybean). For the phosphate fertilization experiments, in randomized complete block design with 4 replications, the treatments were 8 combinations involving corrective and maintenance fertilization in various application modes (Figure 1). In another experiment, in randomized block design with split plots (cultivars) displayed in strips (planting times) with 3 reps, the treatments were: cultivars Jiripoca, BRS 361, Sambaíba, BRS GO 8360, and a local cultivar TGX-1010-14F (control) in three planting dates (07/01/2014; 21/01/2014; 05/02/2014). In a third experiment (fertilization), in plots containing 6 rows 5m long, the treatments were P_2O_5 rates (0, 35, 70, 140 e 280 kg/ha) and K_2O rates (0, 50, 100, 200 kg/ha) manually placed in the furrow. Seeds in all experiments were inoculated (*Bradyrhizobium* sp.) and manually sowed in rows 50 cm apart from each other. Liming (2000kg/ha) was performed manually, spreading lime in the area and mechanically incorporating it into the soil by disc harrowing, immediately before planting. Emergency occurred 6 days after planting in average. Phytosanitary treatments and manual hoeing were made as needed. Flowering and maturity dates were registered and vegetative and reproductive phases and total cycle were calculated. At maturity, the number of plants in the plots was registered and harvesting was performed as the plants in the plots reached maturity. In a sample of plants from one row in each plot plant height and first pod insertion height were measured. Yield (at 13% humidity) was estimated by harvesting the plot central area, measuring the humidity of the grains harvested in that area, and applying the data to the formula: $Y=\text{Kg/ha}=\left(\left(\left(\text{PlotYield} \cdot 10000\right) / \text{HarvestedArea}\right) \cdot \left(100 - \text{GrainHumidity}\right)\right) / 87$ (PESKE et al., 2010).

Results and discussion

The results of the trial on production system models are not showed since in this season the whole sequence of crops started again from the beginning in a new area, and only soybean was planted in all plots. In the phosphate fertilization

experiment the control (zero P_2O_5) yielded 1.06 t/ha and the remaining treatments yielded 1.05 to 1.46 t/ha (Figure 1), showing a non-coherent response to P_2O_5 . According to Hill (2015) soybean responds well to fertile soils with ample amounts of phosphorus and, on average, a single crop of soybeans will take in about 60% of the available phosphorus from the soil. Yields in the trial with cultivars and planting dates were extremely low, ranging from 96 kg/ha to 630 kg/ha, in average of cultivars (Fig. 2.2.), and no significant differences were detected between treatments (Figs 2.1. and 2.4.).

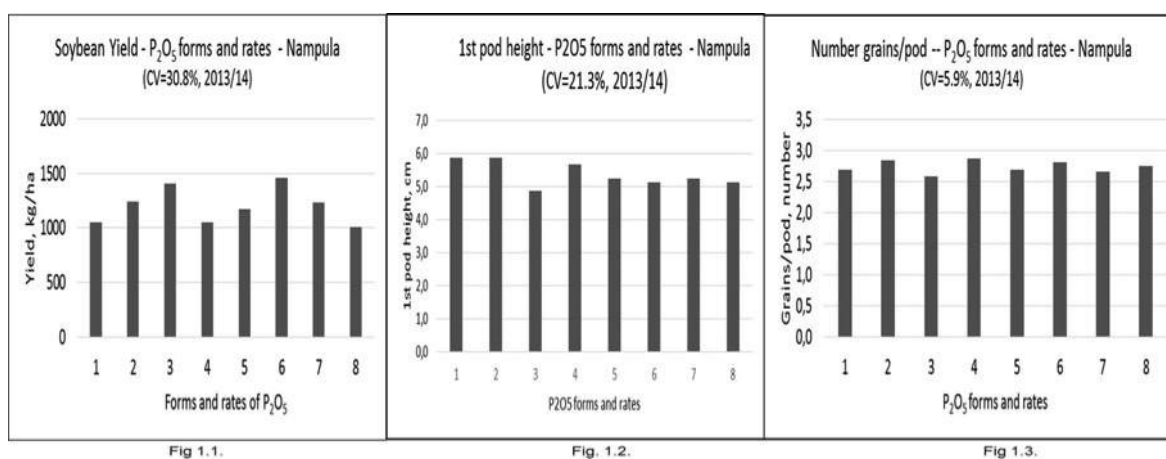


Figure 1. Soybean (cultivar Jiripoca) responses to forms and rates of applied P_2O_5 in Nampula, Mozambique, 2013/2014. Fig. 1.1 – Yield; 1.2 – First pod height; Fig. 1.3. – Number of grains per pod. Treatments: P forms and rates: 1 = 0 P corrective + 0 P maintenance; 2 = 0 P corrective + 80 P maintenance; 3 = 90 P corrective incorporated + 0 P maintenance; 4 = 90 P corrective incorporated + 80 P maintenance; 5 = 90 P corrective superficial + 0 P maintenance; 6 = 90 P superficial + 80 P maintenance; 7 = 22,5 P corrective furrow + 0 maintenance; 8 = 22,5 P corrective furrow + 80 maintenance). No significant differences in yield were detected between treatments.

Contrarily to the former year, the cultivars tended to produce higher yields in the first planting date (Fig. 2.1.), what could be due to the irregular rainfalls in the region and the late first planting date caused by the delay in delivering the seeds to CZN-IIAM, in Nampula. Rainfall is the main factor determining yields of non-perennial crops in tropical regions, since usually it is the sole suppliers of hydric resources during the phenological period of the crop (MARIANO et al., 2006). In average, the 7 Jan planting date produced plants 40 cm tall, which were 5 cm taller than the ones of the 21 Jan planting date (Fig. 2.3.). The data from the third planting date (5 Feb) was discarded due to too many missing plots. The best performing trial in Nampula in the 2013/14 soybean season was the one testing P_2O_5 and K_2O rates (Figure 3.). Soybean yields

ranged from 1.27 to 2.53 t/ha. Although no significant responses were detected between treatments, soybean tended to respond positively to increasing K₂O rates when no P₂O₅ fertilization was provided or under the smallest P₂O₅ rate (35 kg/ha) (Fig. 3.1.).

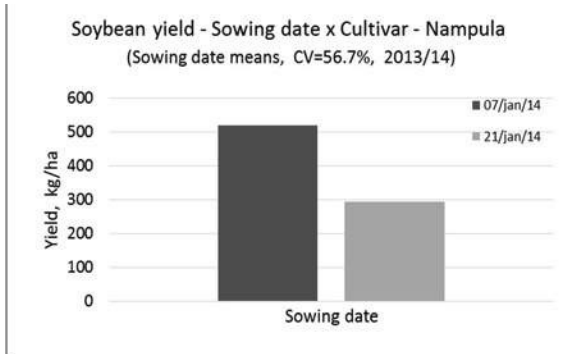


Fig. 2.1

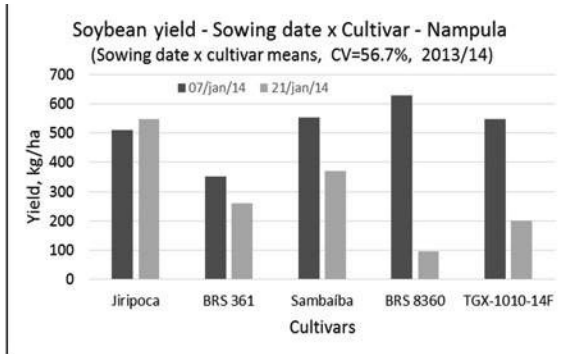


Fig. 2.2

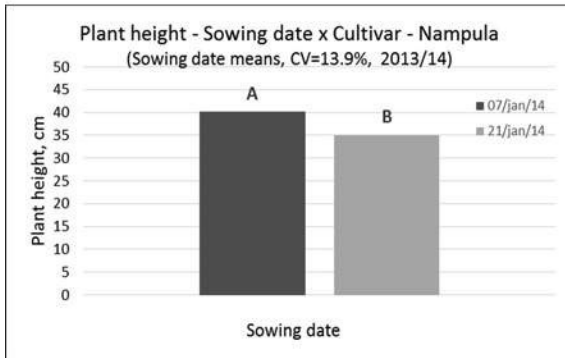


Fig. 2.3

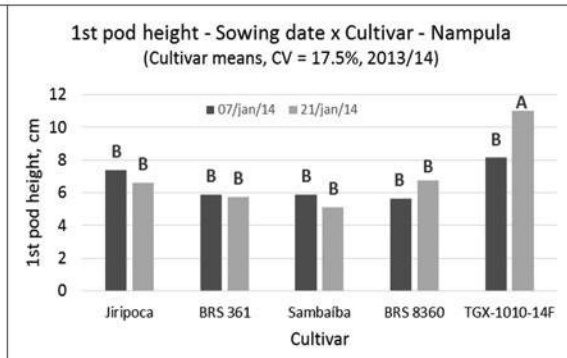


Fig. 2.4

Figure 2. Soybean response to sowing dates in Nampula, Mozambique, 2013/2014. Treatments: Sowing dates (07 Jan; 21 Jan) x Cultivars (Jiripoca, BRS 361, Sambaiba, BRS GO 8360, TGX-1010-14F). Fig. 2.1 – Yield (kg/ha); 2.2 – Yield (kg/ha) Sowing date x Cultivar; Fig. 2.3. – Plant height (cm); Fig. 2.4. – First pod height (cm).

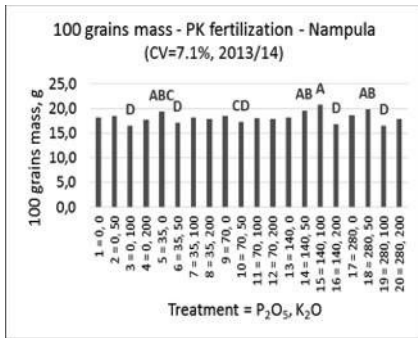


Fig. 3.1

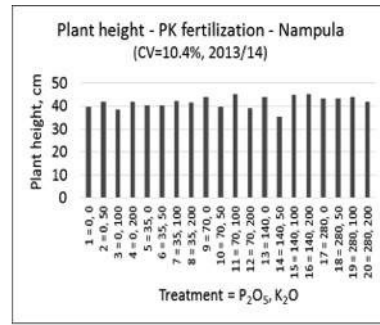


Fig. 3.2

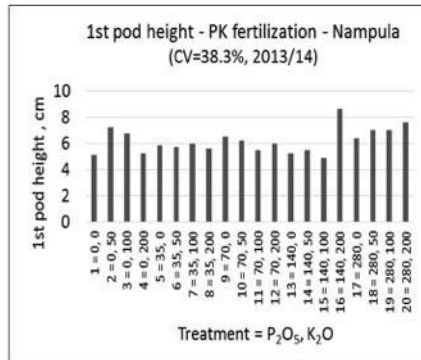


Fig. 3.3

Figure 3. Soybean response to P₂O₅ and K₂O rates, in Nampula, Mozambique, 2013/2014. Treatments: combinations of P₂O₅, (0, 35, 70, 140 e 280 kg/ha) and K₂O (0, 50, 100, 200 kg/ha) rates. Fig. 3.1. – 100 grains mass (g); Fig. 3.2. – Plant height (cm); Fig. 3.3. – First pod height (cm).

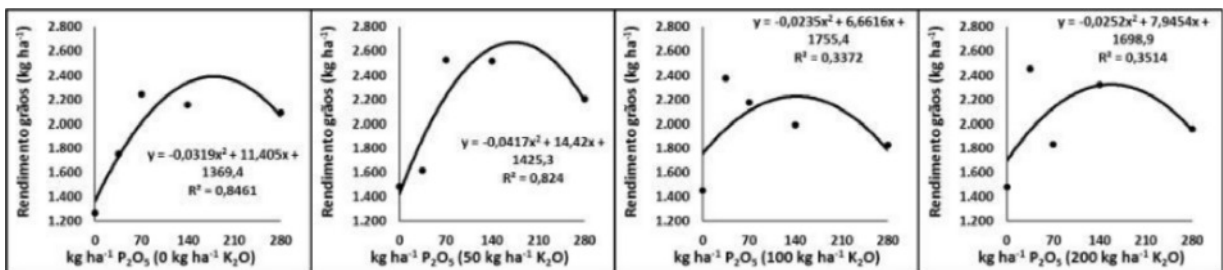


Figure 4. Yield (kg/ha) tendencies of soybean cultivar Jiripoca in response to Phosphorus (0, 35, 70, 140, 280 kg/ha of P₂O₅) in each rate of Potassium (0, 50, 100 e 200 kg/ha of K₂O) fertilization, in Nampula, Mozambique, 2013/2014.

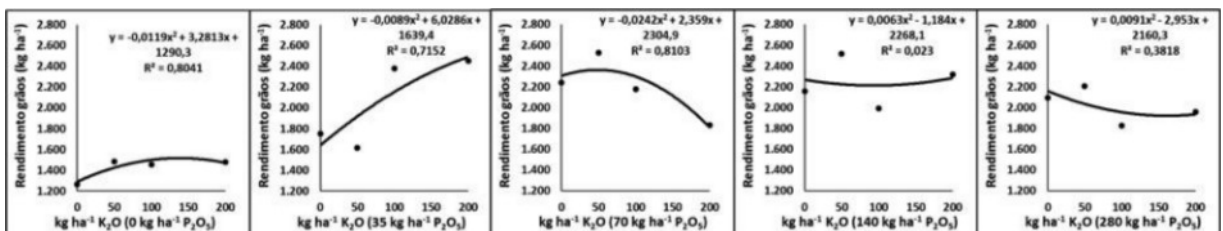


Figure 5. Yield (kg/ha) tendencies of soybean cultivar Jiripoca in response to Potassium (0, 50, 100 e 200 kg/ha of K₂O) in each rate of Phosphorus (0, 35, 70, 140, 280 kg/ha of P₂O₅) fertilization, in Nampula, Mozambique, 2013/2014.

Conclusion

It was not possible to draw hard conclusions from the data collected in the 2013/2014 experiments in Nampula. Better research structure and working conditions are essential for obtaining more precise and less variable data.

Late delivery of the seeds and lack of adequate equipment, in addition to the harsh climate and soil conditions, might have made substantial contribution to compromise data precision and quality.

Despite the difficulties, it was possible to see that early sowing and fertilization around 140 kg/ha of P₂O₅ showed a tendency to produce the highest soybean yields, while yield response to Potassium was less consistent.

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Photo 1. View of the field experiment varieties versus sowing dates.



Photo 2. View of the field experiment encompassing Phosphorus and Potassium increasing rates.