GROWTH AND PRODUCTION OF COTTON IM MURIAZE, NAMPULA PROVINCE, MOZAMBIQUE, AS INFLUENCED BY INCRESASED RATES OF NITROGEN

INFLUÊNCIA DE DOSES CRESCENTES DE NITROGÊNIO NO CRESCIMENTO E PRODUÇÃO DE ALGODÃO EM MURIAZE, PROVÍNCIA DE NAMPULA, MOÇAMBIQUE.

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Resumo

O algodoeiro extrai cerca de 69 kg/ha de nitrogênio para cada tonelada de algodão em caroço produzida, esgotando os solos em poucas campanhas se o nutriente não for resposto por adubação mineral ou orgânica. Solos pobres em matéria orgânica e arenosos são usados para o cultivo do algodão em Moçambique e não há recomendação de adubação estabelecida na área, resultando em baixos níveis de produtividade. Neste trabalho reporta-se estudo que teve por objetivo fazer calibração da adubação nitrogenada e gerar doses recomendadas para a cultura. Para tanto, montou-se esse experimento em Muriaze, Província de Nampula, usando-se como tratamentos as seguintes doses de N: 0, 50, 100, 150 e 200 kg/ha, em delineamento de blocos ao acaso. Cada tratamento teve quatro repetições, consistindo de parcelas de 5 linhas de 5 m cada, espaçadas 0,9 m entre si. Toda a área experimental recebeu calcário (1 ton/ha de calcário dolomítico) e fertilização básica com 150 kg N/ha e 100kg K_2O/ha. A cultivar BRS 293 foi usada no experimento, tendo sido plantada em 21/12/2012, com densidade de 10 plantas por metro linear. Avaliaram-se dados de crescimento e componentes de produção. Forte período de estresse hídrico ocorreu durante o crescimento e florescimento da lavoura, além de surto de lagartas que atacaram os capulhos. Assim, apesar da adubação nitrogenada aumentar o número de capulho/planta, não houve melhoria no crescimento da planta e na produtividade de algodão em caroço. Recomenda-se a repetição do ensaios, em mais de uma localidade na próxima campanha**.**

Key-words: *Gossipium hirsutum* L. Produtividade. Estresses de plantas. Fertilidade do solo. Projeto Pro Savana.

Abstract

Cotton extracts around 69 kg of nitrogen (N) to produce a ton of cottonseed, thus depriving the soil with this nutrient in a few campaigns if it is not replenished by mineral or organic reposition. Soils poor in organic matter are used to cultivate cotton in Mozambique, and there is no fertilizer recommendation established for the area, resulting in low productivity. In this work is reported a study whose objective was to calibrate N fertilizer rates to recommend for this crop. The study was carried out in Muriaze, Province of Nampula, with treatments being the following rates of N: 50, 100, 150 and 200 kg/ha, in a complete randomized block design Every treatment was replicated four times, being each one 5 rows of 5 m each, spaced 0.9 m. All area received a basal fertilization with P_2O_5 equivalent to 120 kg/ha, as Triple Superphosphate, and K_2O equivalent to 120 kg/ha, as Potassium Chloride. It was also limed with one ton/ha of calcium dolomite. The cultivar BRS 293 was used for the experiment, being planted in 21/12/2012, with a density of 10 seeds per lineal meter. It was evaluated parameters of growth and production. There was a severe hydric stress during growth and flowering of cotton, added to a strong attack of caterpillars into the flower buds. So, despite of the N fertilization to increase the number of apples/plant, there was not increase in plant growth and productivity. It is recommended that the experiment be replicated in time and in more than one place in the next campaign.

Key words: *Gossipium hirsutum* L.. Productivity. Plant stress. Soil fertility. Pro Savana Project.

Introduction

Nitrogen (N) is highly demanded by plants, to improve growth, flowering and overall production. On average, to produce a ton of cottonseed is necessary around 69 kg/ha of N, 25 kg/ha of P_2O_5 and 73 kg/ha de K_2O (Carvalho et al., 2011). If not growing on high fertility soils, these nutrients should be made available by proper fertilization. Producers in Brazil that harvest above 5,000 kg cottonseed/ha use around 160 kg of N/ha.

In Mozambique, where cottonseed production is still low, an average 452 kg/ha (Instituto do Algodão de Moçambique, 2012) is produced in soils of low to medium fertility, with low organic matter contents. Cotton is grown mostly in the Mozambican Provinces of Nampula and Cabo Delgado. Mostly soils in these areas are being used for some time, without replenishment of what is taken away with the products, thus natural fertility is running down (Ronquim et al., 2013; Bolfe et al., 2011).

In this paper we describe results of an experiment in which increasing rates of Nitrogen were added to a Sandy soil to have a first insight on how a cotton variety known to be responsive to N would perform in these improved conditions.

Material and Methods

The experiment was conducted into the experimental field of the Instituto de Investigação Agrícola de Moçambique, in Muriaze, Nampula. Soil in the area is a typical sandy soil whose main characteristics are presented in Table 1.

The cotton cultivar studied was the Brazilian BRS 293. This is a midseason high-yield cultivar, that present yield stability, desirable resistance to main cotton diseases, good fibre quality, and is highly adapted to the savannah conditions of central Brazil (Morello et al., 2010). It was planted in 21/12/2012, with a density of 10 seeds per lineal meter. All area received a basal fertilization with P_2O_5 equivalent to 120 kg/ha, as Triple Superphosphate, and K_2O equivalent to 120 kg/ha, as Potassium Chloride. It was also limed with one ton/ha of calcium dolomite.

The following rates of N were tested: 0, 50, 100, 150 and 200 kg/ha. The source of N was Urea. Treatments were distributed at random in a complete blocks experimental design, with four replications each. Experimental plot consisted of five planting rows of 5 m each, spaced 0.9 m.

In 13/06/2013 the experiment was harvested. Evaluations were made considering the plants within four lineal m of the three central rows of every replication. They encompassed characteristics of plant growth (plant height and height of insertion of the first cotton boll) and plant production (final plant stand, number of bolls per plant, average mass of bolls, number of green cotton bolls, number of open bolls, and productivity). The data obtained for each parameter was submitted to variance analysis and regression, and means were compared using Tukey test (Gomes, 1987).

Results and discussions

The increasing rates of N did not influence significantly ($P>0.05$) the plant growth in size neither the height of the first cotton boll (Table 2). There was not influence as well on the average mass of cotton bolls, numbers of open and total bolls per area, or productivity. Is important to point out that a strong water stress that happened when plants were flowering possibly impacted the cultivar performance, impairing a better response to the N rates.

On the other hand, it can be seen that the increasing N rates influenced significantly ($P<0.05$) the number of cotton bolls per plant (Figure 1) and the percentage of open bolls (Table 2). Only 48% of the bolls were open, because of decreasing of temperature during the plant cycle and insects' attacks. With that, productivity was quite low, varying from 592 to 801 kg/ha. If all produced cotton bolls were open, final production would be at least as twice as much what was measured. Using the estimated equation to make a preview of maximum response to N, it could be concluded that with 181 kg of/ha plants would attain their larger number of bolls (or 7.47 cotton bolls/plant) in the studied conditions.

Although there were no significant differences ($P>0.05$) for the final stand of plants (Table 2), when correcting the production data per plant, an interesting pattern is observed (Figure 1B). Is shows that productivity per plant was influenced by the increasing rates in a polynomial

distribution way, with the higher production reached when using the equivalent to 183 kg of N/ha.

Conclusions

Increasing rates of N influenced growth of cotton in the studied conditions.
The rates of N influenced positively the production per plant.
Adverse climatic conditions and pests attacks makes necessary to rerun the experiment over time.

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Table 1. Main characteristics of the soil in the experimental area in Muriaze, Nampula, Mozambique, October 2012.

pH[1]	P[2]	K[2]	Al[3]	Ca[3]	Mg[3]	H+Al[4]	CTCt	CTCe	SB	V	OM	Clay
in water	mg/dm^3					$mmol_c/dm^3$				%	g/dm^3	
6,0	7,5	82	0,0	13,3	4,1	17,4	36,9	19,5	19,5	52,8	11	90

[1]pH in water, 1:2.5 soil:water. [2]Extractor Mehlich-1, 1:10 soil:solution; [3]Extractor KCl 1 mol/L, 1:10 soil:solution; [4]Calcium Acetate 0.5 mol/L, pH 7.0. CTCe – soil natural Cation Exchange Capacity; CTCt – CTC at pH 7,0; SB – Sum of exchangeable basis (K+Ca+Mg); MO – Soil Organic Matter, Walkey-Black method.

Table 2. Effects of Nitrogen rates on final plant stand (FPS), plant height (HP), number of bolls/plant (NBP), average boll mass/plant (ABM), height of first boll (H1B), number of open (NOB) and closed bolls (NCB), percent of open bolls (POB), and productivity per area of cotton cultivar BRS 293 growing in Muriaze, Nampula Province, Mozambique. Cropping season 2012/2013.

Rates of N	FPS	HP	AMB	H1B	NOB	NCB	TNB	POB	PRO
	pl/m	cm	g	Number of cotton bolls/plot				%	kg/ha
0	15	66	5.3	24	119	106	225	48	680.6
50	11	64	5.1	21	138	95	233	41	592.3
100	13	65	5.2	24	128	109	237	46	698.8
150	13	77	5.1	20	142	126	268	47	801.5
200	13	79	5.1	24	77	114	191	60	719.8
					Analysis of Variance				
F value	1.46^{ns}	1.07^{ns}	0.12^{ns}	1.67^{ns}	2.7^{ns}	1.9^{ns}	1.82^{ns}	4.65*	1.31^{ns}
Regression	s/a	s/a	s/a	s/a	EQ	s/a	s/a	EQ*	s/a
Mean	13	70	5.1	23	121	110	231	48	698.6
CV (%)	18.1	19.7	8.8	11.8	26	17.8	17.6	13.7	18.7

*, **, and ^{ns} indicates that the effects are significant at $P < 0.05$, at $P < 0.01$, or not significant ($P>0.05$) respectively. LE indicates that the data shows a better fit within a first grade equation, while PE indicates a better fit within a polynomial second grade equation. $^{s/a}$ indicates no correlation between the tested factors.

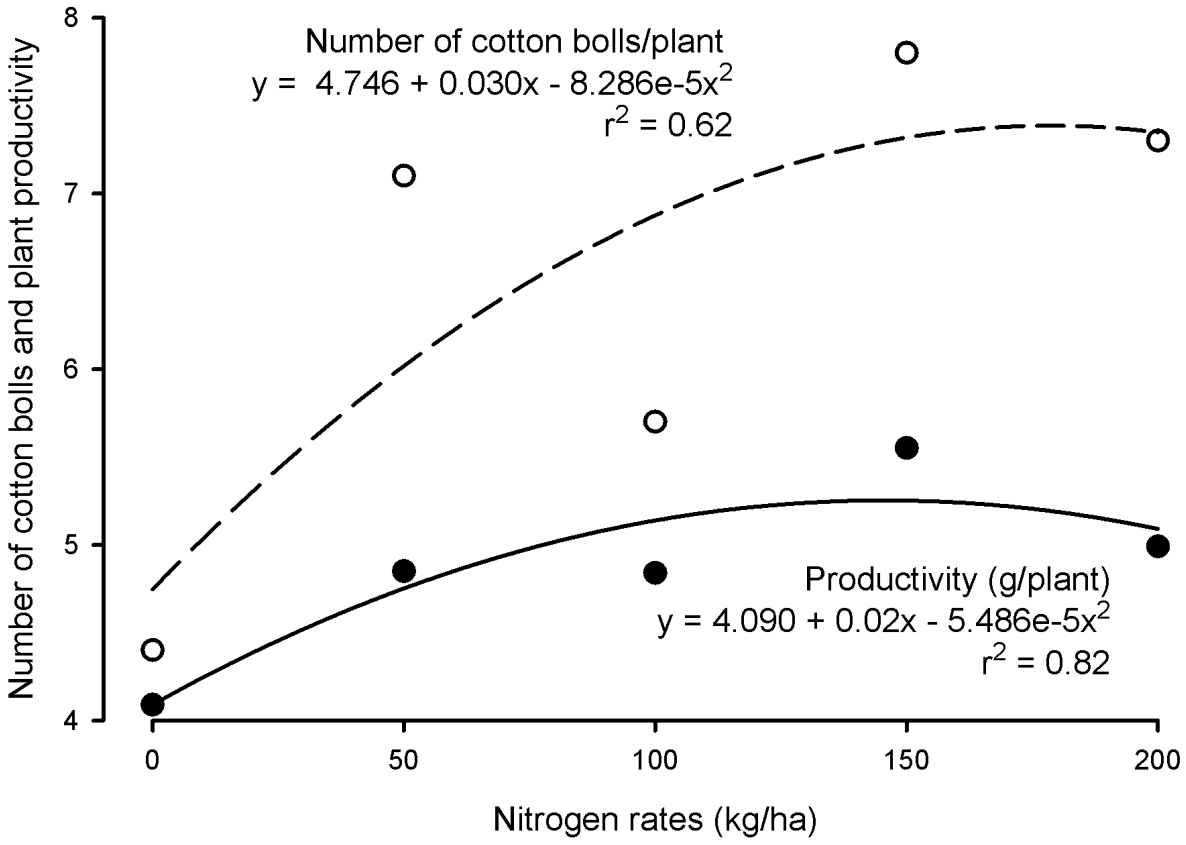

Figure 1. Average production of cotton bolls (number/plant) and cottonseed productivity (g/plant) in response to increasing rates of Nitrogen fertilization. Muriaze, Nampula Province, Mozambique. Cropping season 2012/2013.