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Cotton production using secondary domestic sewage

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ABSTRACT. This study was performed at the campus of the Semiarid Rural Federal University in Mossoró, State of Rio Grande do Norte, and aimed to evaluate the behavior of cotton (*Gossypium hirsutum* L. race latifolium Hatch), cultivar 8h as for growth and yield when fertirrigated with secondary domestic sewage. The experiment consisted of a randomized block split plot design, with dilutions of domestic effluents tested at plot level [25% - T_1, 50% - T_2, 75% - T_3, 100% of secondary domestic sewage - T_4 and 100% water supply with soil mineral fertilization – T_5] on soils of different textures. The plant height was significantly greater at only at 15 and 30 DAP, reaching a maximum value of 67.30 cm with 100% wastewater on the 50th DAP. The cotton production was not influenced by the application of different levels of secondary domestic sewage; but a linear increase of productivity was observed in the sandy soil, reaching 1,363.45 kg ha^{-1} with the application of 100% of domestic sewage. On the Cambisol, the cotton plant presented the best results in terms of morphology.

Keywords: environment, sustainability, reuse.

Produção de algodão usando esgoto doméstico secundário

ABSTRACT. Este trabalho foi desenvolvido no Campus da Universidade Federal Rural do Semi-Árido em Mossoró, Estado do Rio Grande do Norte, com o objetivo de analisar o comportamento do algodoeiro (*Gossypium hirsutum* L. raça latifolium Hatch), cultivar 8h, sobre os aspectos de crescimento e produção, quando irrigado com esgoto doméstico secundário. O delineamento experimental foi o de blocos casualizados com parcelas subdivididas, sendo que em nível de parcelas foram testados proporções de esgoto doméstico secundário [25% - T_1, 50% - T_2, 75% - T_3, 100% de esgoto doméstico secundário - T_4 e 100% de água de abastecimento com adubação mineral do solo - T_5] em dois solos de texturas contrastantes. Com os resultados obtidos verificou-se que a altura de planta só apresentou resultado significante aos 15 e 30 dias após o plantio (DAP), tendo valor máximo de 67,30 cm com a aplicação de 100% de água residuária aos 50 DAP. A produtividade do algodão não foi influenciada pela aplicação das diferentes proporções de esgoto doméstico secundário, entretanto constatou-se um acréscimo linear da produtividade no solo arenoso, atingindo um valor máximo de 1.363,45 kg ha^{-1} com aplicação de 100% de esgoto doméstico secundário. No cambissolo, o algodoeiro apresentou melhores resultados do ponto de vista morfológico.

Palavras-chave: meio ambiente, sustentabilidade, reuso.

Introduction

Currently, drinking water to address the basic needs of the population is increasingly scarce. Besides that there is a lack of implementation of water resource management policies in order to minimize the impacts produced by human activities.

In a global perspective, available water resources are no longer sufficient to adequately supply the population. According to Mancuso and Santos (2003) there are today approximately 26 countries that shelter 262 million people, which represent areas under water shortage. Corroborating with this, several studies have reported an increased and unrestricted exploitation and pollution of water bodies reducing its quality and quantity, restricting thus the possibility of multiple uses (ARAÚJO et al., 2012; FIGUEIRÊDO et al., 2007).

In Brazil water shortage is evident mainly in Northeast. This region has around 58% territory in semi-arid areas, characterized by a short rainy period, high temperature and high evapotranspiration rate (SOUSA et al., 2005).

In this way, water reuse arises as a viable alternative to minimize this situation. The water reuse for irrigation is widely studied and recommended by water researchers and managers to meet water and, largely, nutritional needs of plants (HERPIN et al., 2007). In addition to recovering the effluent, it also reduces environmental pollution and promotes the formation of humus, enables farming activities and human sustainability in areas with harsh conditions.

Despite all these benefits, the use of treated domestic wastewater in agriculture requires adequate techniques for treating and disposal into the environment, since wastewaters have considerable concentrations of dissolved ions such as sodium, boron, chlorides, and a variety of pathogenic organisms such as bacteria, virus, protozoa and helminth. Moreover, secondary domestic sewage presents bacteria and algae that promote the formation of biofilm in drip irrigation systems resulting in reduced flow and consequently in the uniformity of effluent application (BATISTA et al., 2011a and b).

These characteristics comprise a complicating factor in the use of treated domestic wastewater in agriculture (DEON et al., 2010; DUARTE et al., 2008; SOUZA et al., 2011). However, according to Rocha et al. (2003), after 54 days of application of treated sewage it was not identified fecal coliforms on the soil, and from 60 days, was not found positive samples with helminth eggs, despite the high degree of initial contamination. In the study of Souza et al. (2011) it was not verified thermotolerant coliforms on the surface and at 1.0 m depth in a cambisol cultivated with coffee and supplied with secondary sewage.

The practice of reusing needs to be performed with responsibility to prevent uncontrolled application in the soil, reducing thus the environmental contamination. Little scientific literature is available regarding the reuse of treated domestic sewage applied to cotton crops, in contrast to its economic relevance, as well as the scarcity of water for irrigation in the semi-arid northeastern region.

This study aimed to analyze the production of cotton by using secondary domestic sewage to replace conventional fertilization in two types of soil.

Material and methods

This work was developed in an experimental area of the Department of Environmental Science and Technology of the Rural Federal University of the Semi-Arid (UFERSA), in Mossoró, Rio Grande do Norte State, located at 5º11'S and 37º20'W, and mean latitude of 18 m. The local climate is BSwh', based on the Köppen classification, and the mean annual rainfall is 678 mm.

The experiment was conducted from November 2009 to March 2010. The cotton crop cycle lasted 115 days after planting. Forty eight seeds were sowed per subplot, two rows with 24 seeds each.

Assessments were performed with the Cotton cv. 8H, (*Gossypium hirsutum* L. race *latifolium* Hatch), by comparing the effect of adding effluent with mineral fertilizer (control) and two types of soil. The experimental design adopted was randomized blocks with split plots, with the levels of addition of secondary domestic sewage on the main plots [25% - T1, 50% - T2, 75% - T3, 100% of secondary domestic sewage – T4, and water supply + mineral fertilizer on the soil - T5], and with two types of soil with contrasting textures in the sub-plots, Latosol (S1) and Cambisol (S2). The treatments were arranged into 20 experimental plots with 1 m^2 (0.50 x 2.00 m), each plot split into two sub-plots (soils), totaling 40 experimental units, with five levels of secondary domestic sewage, two types of soil and four replications.

The stabilization pond of the Domestic Wastewater Treatment Plant of Cajazeiras in Mossoró, Rio Grande do Norte State, belonging to the CAERN (Water and Sewage Company of Rio Grande do Norte State) located at the community of Passagem de Pedras, provided the urban sewage that was transported every week from the stabilization pond to the local of the experiment in 1000 liter-tank, volume sufficient to prepare the water for irrigation to be used for a week. In agreement with Standard Methods for the Examination of Water and Wastewater (APHA, 2005) it was characterized the secondary domestic sewage used in the experiment as for its physical, chemical, and microbiological properties (Table 1).

Table 1. Characteristics of the treated sewage used for fertigation of cotton crops.

Parameters*	Unit	Results
BOD	mg L^{-1}	35.00
pH	-	7.40
EC	dS m^{-1}	1.75
Ammonia	mg L^{-1}	20.16
Nitrate	mg L^{-1}	0.007
Chloride (Cl^-)	mg L^{-1}	339.50
Sodium (Na)	mg L^{-1}	33.00
Calcium (Ca)	mg L^{-1}	181.44
Magnesium (Mg)	mg L^{-1}	21.86
Phosphorus (P)	mg L^{-1}	3.16
Potassium (K)	mg L^{-1}	85.00
Thermotolerant coliforms (TC)	TC 100 mL^{-1}	4.6×10^5

*BOD = Biological oxygen demand and EC = Electric conductivity at 25°C.

Experiments were carried out with two types of soil, the Latosol with sandy texture, and Cambisol with clayey texture, whose characteristics are listed in Table 2. The soils for the experiment were extracted from the layer 0-20 cm, in virgin soil areas.

The sandy soil was collected from a forested area, in the Experimental Farm of UFERSA ‘Rafael Fernandes’, 21 km far from Mossoró, Rio Grande do Norte State. The clayey soil was gathered from virgin soil area, belonging to the Company WG, located at the rural area of the municipality of Baraúna, Rio Grande do Norte State, 30 km far from Mossoró.

The plots of sandy soil under chemical fertilization were limed, aiming to raise its base saturation to 70%. For this, it was used a dosage of 1.67 ton ha^{-1} dolomitic limestone, increasing thus the Mg levels in the soil.

After the soil liming, it was determined the requirement for foundation and topdressing fertilization in the treatment that used only water for irrigation, as recommended by Embrapa (2006), for upland cotton crops grown in the Cerrado. According to the levels in soils and an expected yield of 5 ton ha^{-1}, it was applied to the foundation fertilization of 25 kg ha^{-1} N, 90 kg ha^{-1} P for both soils and 30 kg ha^{-1} K only to the sandy soil. Furthermore, 40 kg ha^{-1} sulfur was recommended, via magnesium sulfate, for both soils regarding the requirement of the crop.

For the topdressing fertilization, it was applied 125 kg ha^{-1} N to both soils, and 140 kg ha^{-1} K to the sandy soil. The topdressing was divided into two steps, the first 25 days after emergence, with the application of half of N and 40% of K. On the second phase, the remaining N and K were applied at early flowering, 50 days after planting. The other treatments received these elements during the fertigation with wastewater, up to 100 days after planting.

The trickle irrigation system was adopted, by using microtubules as emitters, with 1.5 internal diameters, to avoid clogging by suspended particles in the effluent. The water supply was performed through individual tanks with capacity of 310 L each, suspended in such a way to achieve a water column of 1.2 m. Every week, the tanks were filled up with volumes corresponding to each treatment. The system for water distribution consisted of five lateral rows with 14 mm in diameter, independent to each treatment, along each block, and according to the randomization of the plots. Eight microtubules were assembled on the sidelines of each plot, spaced at 0.25 m, being this required for the meeting between the bulbs, aiming to form a single wet area within each plot. Furthermore, it was used 2.00 m length microtubules for each emitter, obtaining a mean flow of 3.3 L h^{-1}.

The estimation of crop evapotranspiration was undertaken daily from the reference evapotranspiration (ETo), where the Kc was calculated using the Dual Kc method (ALLEN et al., 2006), which separates the transpiration from the evaporation of the soil: Kc = Kcb + Ke, where Kcb is the basal Kc – without soil evaporation and Ke, is the soil evaporation coefficient. Despite using two soils with different characteristics, it was adopted the greatest water depth presented by the clayey soil, since this presented greater limitation to the crop development under water stress.

The irrigation was suspended 100 days after planting, owing the great amount of plants with vigorous vegetative growth, flower, and bolls to be open. By the end of this period it was applied a total irrigation of 582.8 mm, equivalent to 582.8 liters of water per sub-plot.

For the morphological assessment of the plants aiming to monitor the growth and development, four plants were randomly chosen within each sub-plot to evaluate the following variables: plant height, by measuring from the lap of the plant to the apex (apical meristem) performed at 15, 30, 50, 70, 95 and 115 days after planting, and phytomass, by collecting the shoot (stem and leaf) of four plants of each sub-plot and drying in forced-air circulation oven at 60°C until constant weight.

In order to calculate the yield, it was harvested the production of all plants in the experimental area. Considering the concern about the rainfall events, the bolls were harvested as soon as they had opened and ease of release, performing thereby the sum of each harvest to determine the production and its components (number and average weight of flower buds per plant) per plot. In this case, the yield was based on the productivity (ton ha^{-1}), estimated by the length of sub-plots and spacing between them.

Table 2. Physical and chemical characteristics of the soils used in the experiment.

Soil	pH	OM	P	K^+	Na^+	Ca^{2+}	Mg^{2+}	Al^{2+}	(H+Al)	SB	t	CEC	V	m	ESP
			......mg kg^{-1}.....				......................cmol$_c$ dm^{-1}............................						..........%.........		
Latosol	5.8	0.32	4.2	39.3	1	0.5	0	0	2.31	0.6	0.6	2.91	21	0	0
Cambisol	6.7	0.95	7.2	378.2	21.9	8	1.9	0	1.16	10.96	10.96	12.12	90	0	1

Soil	Soil density kg m^{-3}	Porosity cm^3 cm^{-3}	Sand	Silt	Clay	Moisture (g cm^{-3}) 0.01 MPa	1.5 MPa
			......................g kg^{-1}............................				
Latosol	1400	45.95	930	30	50	0.112	0.028
Cambisol	1280	52.58	590	180	220	0.32	0.154

*OM = organic matter (g kg^{-1}). ESP = Exchangeable sodium percentage and CEC = Cation exchange capacity.

Data were subjected to an analysis of variance using the software SISVAR (FERREIRA, 2008). The sources of nutrients (mineral fertilizer and wastewater) and soils were analyzed with the F test, at 1 and 5% probability. Besides that, a Dunnett test was performed to compare the mean values between mineral fertilization (control) and levels of wastewater. The quantitative factor relative to the percentage increase of use of wastewater was analyzed by means of polynomial regression (linear and quadratic).

Results and discussion

The summary of the ANOVA for dry phytomass of leaf, stem, and flower buds and for the number of flower buds at 50 DAP evidenced a significant increase only for the dry phytomass of the stem and for the dry phytomass of flower buds comparing the yield of these parameters as a function of amounts and sources of nutrients (Table 3).

A linear increasing effect ($R^2 > 0.40$) was detected for the accumulation of dry phytomass of cotton leaves as a function of levels of wastewater applied, with the highest mean accumulation of DPL of 9.31 g observed for the level of 100% of wastewater (Figure 1A). Moreover, the accumulation of dry phytomass of stem, flower buds and number of flower buds were affected by the levels studied, being distinct the effects according to the level of wastewater applied.

The best fit was the quadratic ($R^2 > 0.80$), so that the response of the crop was increased up to a maximum of 12.6 g, with a downward trend of the dry matter with an application of 69.70% of wastewater (Figure 1B). There was an increase of dry mass in flower buds (1.96 g) with an application of 65.6% of wastewater (Figure 1C), and in the number of flower buds (10.38 buds) for the level of 72.21% of wastewater (Figure 1D).

In relation to the effect of soils on the production of dry matter of leaf, stem, flower buds, and number of flower buds, there was a significant effect at 1% probability (Table 3). The Cambisol had the best performance when compared with the Latosol in relation to the performance of the dry matter and number of flower buds in the cotton plant.

The interaction between the sources of nutrients with the types of soil was not significant.

The Table 4 lists the summary of the ANOVA for the plant height in different periods of evaluation subjected to increasing percentages of reuse of wastewater and chemical fertilizer in two different soils. For the height of cotton plants a significant effect ($p < 0.01$) was verified at 15, 30 and 50 DAP ($p < 0.05$) when compared with the sources of nutrients (percentages of wastewater and mineral fertilizer) (Table 4).

The effects of treatments with different levels of wastewater were significant after unfolding the degrees of freedom into orthogonal polynomials with linear behavior, at 15 DAP ($p < 0.01$) (Figure 2A), at 30 DAP ($p < 0.05$) (Figure 2B) and at 50 DAP ($p < 0.01$) (Figure 2C).

Table 3. Summary of ANOVA and means for the variables dry phytomass of leaf (DPL), of stem (DPS), of flower buds (DPFB) and number of flower buds (NFB) at 50 days after planting (DAP), subjected to increasing percentages of wastewater and chemical fertilizer in Latosol and Cambisol.

Sources of variation	Degree of freedom	Variables			
		DPL	DPS	DPFB	NFB
		Statistic F			
Sources of nutrients (SN)	4	2.17^{ns}	3.18*	8.50**	1.89^{ns}
Level of wastewater (LW)	3	3.85*	5.83*	3.16^{ns}	2.61^{ns}
E linear	1	5.04*	5.31*	2.86^{ns}	2.43^{ns}
E quadratic	1	4.26*	9.36*	6.51*	5.23*
Error 1	12				
Soil (S)	1	57.19**	78.83**	89.30**	43.30**
SN x S	4	1.49^{ns}	1.75^{ns}	1.70^{ns}	1.96^{ns}
Error 2	15				
CV_1		31.52	35.95	28.95	26.62
CV_2		34.65	32.51	30.41	29.69
Sources of nutrients (SN)		Means (g)			
T_1 (25% LW)		6.44^{ns}	7.46^{ns}	1.34$^{\#}$	7.17^{ns}
T_2 (50% LW)		1.76^{ns}	10.37^{ns}	1.89$^{\#}$	9.80^{ns}
T_3 (75% LW)		10.13^{ns}	14.06^{ns}	2.11^{ns}	9.93^{ns}
T_4 (100% LW)		8.25^{ns}	10.09^{ns}	1.73$^{\#}$	8.96^{ns}
T_5 (Mineral fertilizer)		8.88	12.03	2.94	9.94
Soil					
Latosol		4.86b	5.87b	1.09b	6.33b
Cambisol		11.73a	15.74a	2.91a	11.99a

** e * significant at 1 and 5% probability, respectively; ^{ns}non-significant at 5% by the F test; $^{\#}$the treatments differ from the control at 5% probability by the Dunnett's test; ^{ns}, the treatments do not differ from the control.

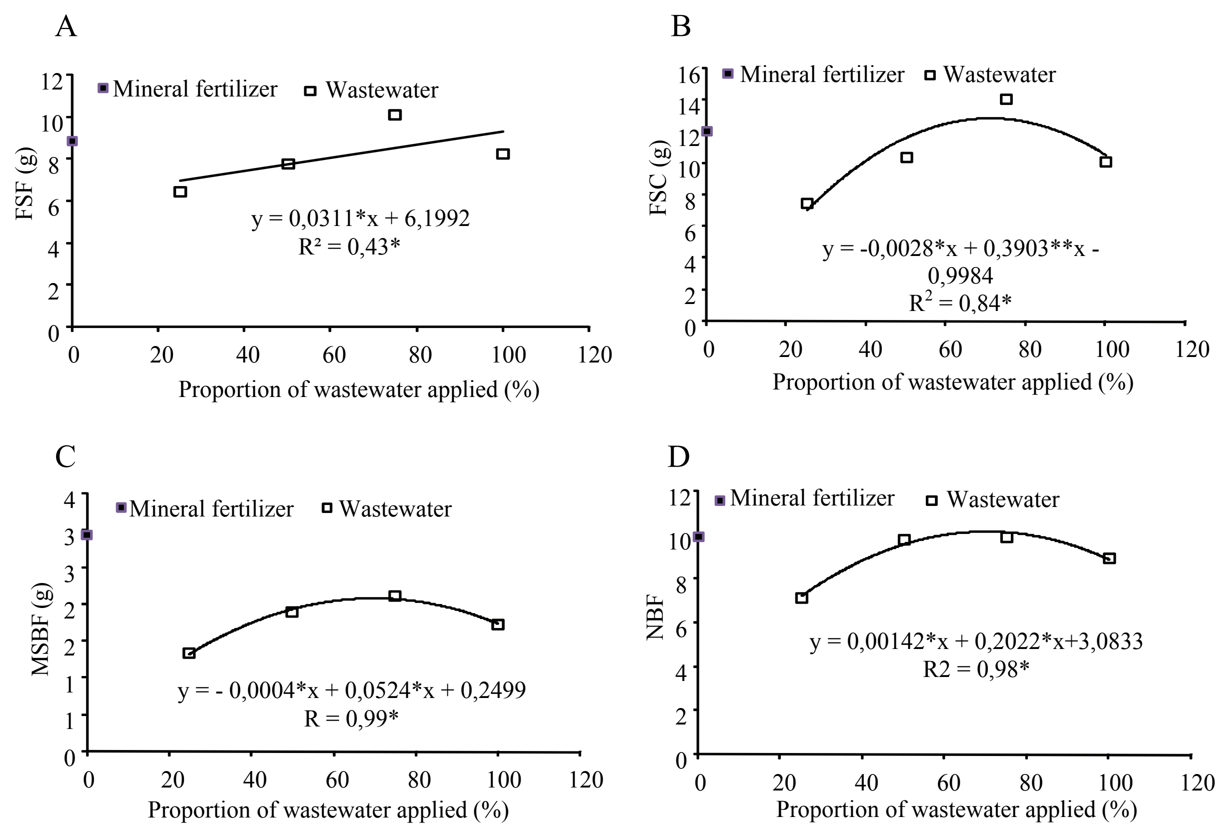

Figure 1. Dry phytomass of leaf - FSF (A), stem - FSC (B), flower buds - MSBF (C) and number of flower buds - NBF (D) at 50 DAP, as a function of levels of wastewater applied.

Table 4. Summary of ANOVA for the plant height at 15, 30, 50, 70, 95 and 115 days after planting (DAP), subjected to increasing percentages of wastewater and chemical fertilizer on two different soils.

Source of variation	Degree of freedom	Mean square					
		Days after planting – DAP					
		15	30	50	70	95	115
Source of nutrientes (SN)	4	67.30**	18.07**	4.58*	1.67^{ns}	2.33^{ns}	1.49^{ns}
Level of wastewater	3	16.63**	2.71^{ns}	4.58*	1.49^{ns}	2.47^{ns}	1.61^{ns}
E. Linear	1	40.38**	5.53*	10.89**	3.3^{ns}	5.21^{ns}	4.25^{ns}
E quadratic	1	5.39*	2.51^{ns}	2.83^{ns}	0.50^{ns}	0.00^{ns}	0.55^{ns}
Error 1	12						
Soil (S)	1	153.41**	343.1**	101.44**	166.28**	78.89**	52.51**
SN x S	4	0.98^{ns}	6.21**	2.40^{ns}	2.70^{ns}	0.70^{ns}	0.53^{ns}
Error 2	15						
CV_1	%	7.31	11.33	11.43	15.32	20.07	17.05
CV_2	%	8.23	7.81	11.81	9.22	11.93	14.61

** and * significant at 1 and 5% of probability, respectively; ^{ns}non-significant at 5% by the F test; $^{\#}$the treatments differ from the control at 5% probability by the Dunnett's test; ^{ns}, the treatments do not differ from the control. CV = coefficient of variation.

Regarding the plant height, the coefficient of determination was satisfactory at 15 DAP (R^2 > 0.90). In this way, the maximum value for plant height at 15 DAP was found for the level of wastewater of 96.30% (14.1 cm). At 30 DAP, with the significant effect between the sources of nutrients and soils, it was verified the maximum values of plant height with the level of wastewater of 100% (26.9 cm), for the Latosol; while for the Cambisol, the maximum value was found for the level of 63.22% (40.30 cm). At 50 DAP, this maximum was registered for the level of 100% of wastewater (67.30 cm) (Figure 2).

Fideles Filho et al. (2005) examined parameter of growth and development of cotton plants when fertigated with wastewater and well water, and observed that the height of plants exclusively fertigated with wastewater had always been above the other treatments. Alves et al. (2009) observed that applications of wastewater on fertilized soil has no effect on the development of cotton plants, but without fertilization, the leaf area increased with increased water depths of wastewater.

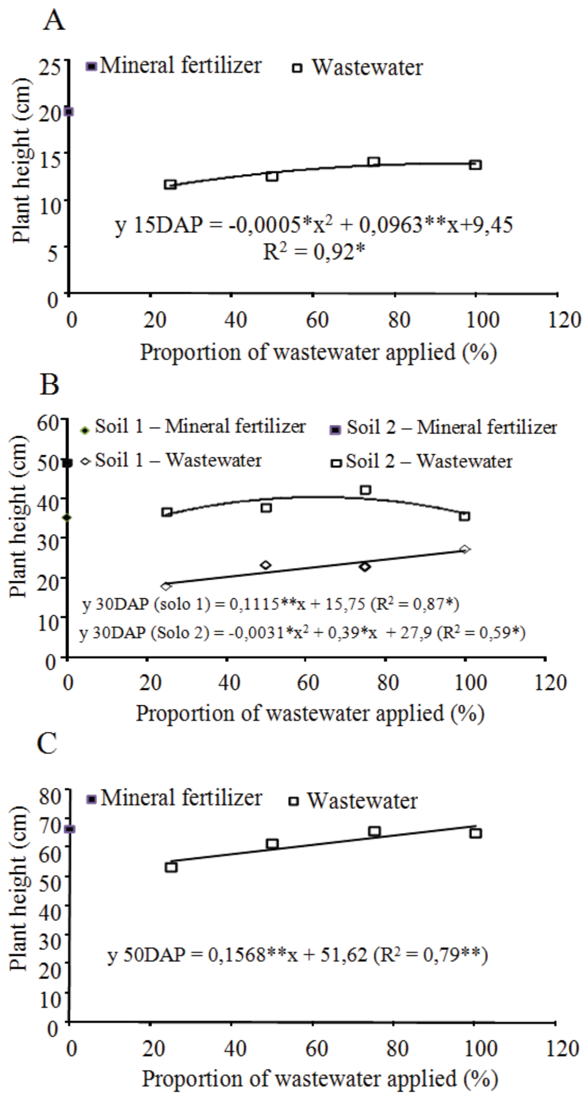

Figure 2. Height of cotton plants at 15 (A), 30 (B) and 50 DAP (C) as a function of the level of wastewater applied.

Other authors have already achieved significant and positive effects of fertigation with domestic effluent on other species. For instance, Rebouças et al. (2010) concluded that the increase in the level of effluent of maturation pond in the water supply for fertigation of cowpea increased the production of dry matter of root, stem and leaf, indicating the proportional growth of plants. Souza et al. (2010) working with the sunflower genotype BRS OÁSIS for cutting, also obtained significant effects for the use of wastewater in relation to the supply water for all growth variables studied.

The best performances using the wastewater on the growth of cotton plants were probably due to the availability of nutrients to the plants, especially N present in the wastewater (Table 1), since it is the most limiting nutrient for crop production, promoting a reduction of up to 60% in the productivity owing its deficiency (SMIDERLE et al., 2005). Furthermore, wastewater has phosphorus and potassium, which also contribute to a good development of cotton plants.

For the effect of the different soils, this was significant ($p < 0.01$) at 15, 30, 50, 70, 95 and 115 DAP. Analyzing the mean values in the Table 4, it is possible to notice that the yield on the Cambisol is higher than on Latosol. On the other hand, when compared the responses in the soils as a function of treatments with different levels of wastewater and control, a significant influence was detected up to the 50 DAP.

A regression analysis pointed out a linear behavior on the Latosol, and quadratic on the Cambisol (Figure 2B). For the Latosol the behavior of the plant height as a function of the levels of wastewater is growing, with a maximum value of plant height for the level of 100% (26.90 cm). For the Cambisol, there is an upward trend in the plant height up to a maximum value and after this, it tends to decrease. At 30 DAP it was determined the mean values of plant height, showing that the interaction source of nutrients vs. soil was significant in all treatments with higher values in the control (Table 4).

The sources of nutrients had no significant effect on the crop yield. Likewise, the levels of wastewater had no significant effect on the yield of cotton crop (Table 5).

Table 5. Summary of ANOVA and means for the yield of cotton plants (Fiber + Grain) by the end of the cycle, subjected to growing percentages of wastewater (LW) and chemical fertilizer in two different soils.

Source of variation	DF	Variable Yield
Sources of nutrients (SN)	4	1.70^{ns}
Level of wastewater (LW)	3	0.68^{ns}
E linear	1	0.43^{ns}
E quadratic	1	0.84^{ns}
Error 1	12	
Soil (S)	1	105.55**
SN x S	4	3.48*
Error 2	15	
CV_1		19.89
CV_2		21.77
Sources of nutrients (SN)	Means (kg ha^{-1}) Latosol	Cambisol
T_1 (25% LW)	746.5^{ns}	2498.56^{ns}
T_2 (50% LW)	1010.3^{ns}	1876.08#
T_3 (75% LW)	1095.8^{ns}	2165.81^{ns}
T_4 (100% LW)	1390.5^{ns}	$1980.06^{\#}$
T_5 (Mineral fertilizer)	1027.4	2534.75
Soil		
Latosol		1056.15b
Cambisol		2211.65a

** and * significant at 1 and 5% probability, respectively; ^{ns}non-significant at 5% by the F test; $^{\#}$the treatments differ from the control at 5% probability by the Dunnett's test; ^{ns}, the treatments do not differ from the control. CV = coefficient of variation.

There was a significant effect ($p < 0.01$) between the types of soils, whereas the sources of nutrients and types of soils had a significant interaction ($p < 0.05$). The cotton crop cultivated on Latosol, when subjected to increased levels of wastewater, presented an increasing linear trend of yield (Figure 3). Nevertheless, on the Cambisol it was not possible to determine a mathematical model for the plant yield behavior.

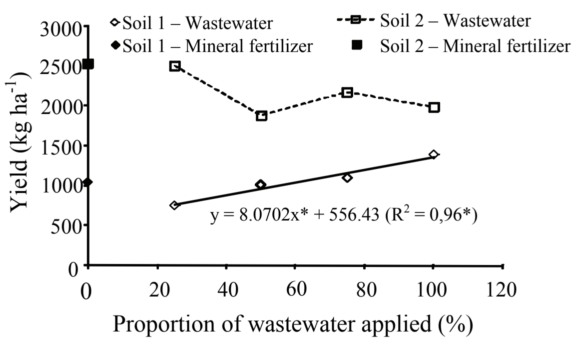

Figure 3. Regression analysis and means for yield by the end of crop cycle.

For the interaction between Latosol and levels of wastewater, the model with the best fit was the linear ($R^2 > 0.96$). The values of crop yield increased as a function of levels of wastewater, reaching a maximum value of 1.363,45 kg ha^{-1} with application of 100% of wastewater.

For the Cambisol, the productivity did not fit either linearly or quadratically, with the highest productivity mean obtained for the level of 25% of wastewater. This can be explained by the high concentration of salts in the wastewater (electrical conductivity equal to 1.75 dS m^{-1}) and consequent accumulation of salts in the root zone of Cambisol with the water applied in the irrigation (PORTO FILHO et al., 2011), once its clayey texture 220 g kg^{-1} clay (Table 1) prevented the leaching of excessive salts as usually occurs in sandy soils like Latosol - 930 g kg^{-1} sand (Table 1). The effects of excessive salts in the soil on the plants may be caused by reduced water absorption, toxicity of specific ions, and by the interference of salts in physiological processes (indirect effects), which reduce the growth and development of plants (DIAS; BLANCO, 2010).

Moreover, the greater productivity of cotton in the Cambisol was obtained using the level of 25% of wastewater. This is explained by the probable reduction of at least 70% in the EC of wastewater, resulting in a lower accumulation of salts and reduced effects of salinity on plants, once the soil salinity is proportional to the EC of irrigation water, and the accumulation of salts on the soil varies according to the soil texture (PORTO FILHO et al., 2011).

Fideles Filho et al. (2005) proved that the yield of cotton fertigated with wastewater was higher than irrigated with well water, with and without organic manure (humus). The yield of cotton fertigated with wastewater exceeded in 59% the treatment with well water. Compared with the treatment irrigated with well water + organic manure, the superiority was on the order of 23%.

Conclusion

The mean plant height was significant at 15 and 30 DAP in all levels of wastewater compared with the control. The maximum height at 50 DAP was 67.30 cm verified with the application of 100% of wastewater.

The response of the yield on the Latosol was linear, reaching a maximum value of 1,363.45 kg ha^{-1} with application of 100% of wastewater.

The Cambisol presented better results from the morphological point of view compared with the Latosol for all the parameters evaluated in the plant.

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