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Tillage effects on the development of several cotton cultivars in Southwest of Bahia, Brazil

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Abstract

Cotton (*Gossypium hirsutum* L.r. *latifolium* Hutch) is very sensitive to soil conditions. The Iuiu Valley, located in the Southwest of Bahia State in Brazil, was an important area for cotton production but an inadequate soil management for years and consequent soil quality degradation lead to the decline of the crop in the region. In an effort to re-establish cotton, this study was carried out to identify a sustainable soil management system for cotton production in the region. The experiment was carried out in Palmas de Monte Alto (Bahia, Brazil) on an Eutrichrept soil, and consisted of eight treatments (two tillage systems and four cotton cultivars). The field lay-out was a split-plot with tillage systems as main plots and cultivars as subplots. The tillage systems consisted of conventional and reduced tillage and cotton cultivars used were 'BRS Aroeira', 'BRS 201', 'Delta Opal' and 'BRS Cedro'. No significant differences were observed between the two tillage systems for plant height, stem diameter, boll weight, yield, fiber percentage, and fiber length. Conventional tillage promoted higher fiber length and uniformity for BRS 201 as well as higher fiber resistance for the other three cultivars. On the other hand, reduced tillage promoted higher micronaire index values for Delta Opal. The BRS Cedro cultivar showed a greater plant height independently from the tillage system. In conclusion, reduced tillage allowed a sustainable soil management without compromising cotton yields and quality.

Additional key words: fiber quality, *Gossypium hirsutum,* micronaire index, soil compaction, soil tillage.

Resumen

Efectos del laboreo en el desarrollo de varios cultivares de algodón en el sudoeste de Bahía, Brasil

El algodonero (*Gossypium hirsutum* L.r. *latifolium* Hutch) es muy sensible a las condiciones del suelo. El Valle del Iuiu, localizado al suroeste del estado de Bahía en Brasil, se destaca como una importante zona productora de algodón, pero el inadecuado sistema de manejo del suelo durante años y la consiguiente degradación de la calidad del suelo han ocasionado el declive de este cultivo en la región. En un esfuerzo por reestablecer este cultivo, se realizó un estudio para identificar un sistema de manejo del suelo sostenible para la producción de algodón en la región. El experimento se llevó a cabo en Palmas de Monte Alto (Bahía, Brasil) sobre un Eutrochrept, y constó de ocho tratamientos (dos sistemas de laboreo y cuatro cultivares de algodón) en un diseño experimental en bloques aleatorios, en esquema de parcela subdividida. Los sistemas de laboreo consistieron en un laboreo convencional y un laboreo reducido y los cuatro cultivares utilizados fueron 'BRS Aroeira', 'BRS 201', 'Delta Opal' y 'BRS Cedro'. No se observaron diferencias significativas entre los dos sistemas de laboreo para la altura de plantas, diámetro del tallo, masa de capullos, productividad, porcentaje y longitud de fibras. El laboreo convencional promovió unas mayores longitud y uniformidad de fibras para BRS 201, así como una mayor resistencia de fibras para los otros tres cultivares. Por otra parte, el laboreo reducido proporcionó mayores valores de índice de micronaire

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para Delta Opal. BRS Cedro presentó una mayor altura de plantas, independientemente del sistema de laboreo. En conclusión, el laboreo reducido permitió un manejo sostenible del suelo sin detrimento de la producción de algodón ni de su calidad.

Palabras clave adicionales: calidad de fibras, compactación del suelo, *Gossypium hirsutum,* índice de micronaire, sistema de laboreo.

Introduction

Iuiu Valley, located in the South West of the Bahia State in Brazil, has been an important cotton production region, reaching up to 19% of Brazilian cotton production in the 1980s. However, due to different factors, mostly an incorrect soil management, this crop lost importance in the region (Fernandes *et al.*, 2007). Heavy harrow was the most used equipment in the Iuiu Valley, since it presented a high operational capacity. However, the continuous using of this equipment causes soil compaction. Moreover, cotton intensive monoculture during several years with no cultivar diversity resulted in yield losses and the decay of this culture in the region (Rezende, 2003); declining from approximately 330,000 ha cultivated in 1988 to 30,000 ha in 2003. These inadequate practices were caused by the lack of research on the region and the lack of information by the farmers.

Tillage affects directly to soil properties, thus, influencing plant growing conditions. The use of large, heavy field equipment may compact soil or reduce its productivity (Phillips and Kirkham, 1962; Gameda *et al.*, 1987). When soil is compacted, its particles are rearranged such as the total pore space is decreased, whereas bulk density is increased (Singer and Munns, 1987). In most cases, the larger soil pores (macropores) are destroyed by the compactive force exerted on the soil, which results in reduced content and movement of air, water, heat and nutrients in the soil. Compaction also increases soil strength, thereby increasing the resistance to root penetration. When plant roots cannot explore the entire soil structure, plant nutrients become positionally unavailable.

Adoption of conservation tillage and cover crop systems offers a practical means of preserving soil productivity and increase water infiltration. In addition, conservation tillage can influence the amounts of supplemental N needed to achieve optimal cotton yields (Boquet *et al.*, 2004). However, as pointed out by Sainju *et al*. (2006), sustainable management practices still remain a challenge for cotton production systems. Some producers are also concerned about whether conservation tillage will adversely affect fiber quality and yields. While fiber properties that comprise fiber quality are controlled largely by heredity, there is an evidence indicating that they are also influenced and modified by environmental effects that affect boll production and fruiting patterns (Bradow and Davidonis, 2000). Environments producing plant stress can reduce quality by causing plants to develop shorter, thicker and less uniform fibers. Some studies showed that tillage exerts an influence on fiber quality traits (Boquet *et al.*, 2004), although the small differences observed were not sufficient to justify practical or economic concern.

In fact, the effect of tillage on cotton yields and plant and fiber traits has been variable. Some studies showed that cotton yields were similar or greater in no-tillage than in conventional tillage (Nyakatawa and Reddy, 2000; Boquet *et al.*, 2004). Others (Ishaq *et al.*, 2001; Schwab *et al.*, 2002; Ozpinar and Isik, 2004) reported lower yields under no-till or reduced-till than under till management. Daniel *et al.* (1999) and Stevens *et al*. (1992) found no differences in cotton yield between no-till and conventional till managements. Still others have found that enhanced cotton yields with conservation tillage were observed after several years (Triplett *et al.*, 1996).

The objective of this study was to compare the effects between conventional and reduced tillage systems on cotton yield and quality and to determine whether cultivars responded differently to tillage methods.

Material and methods

This experiment was conducted at the «Centro de Profissionalização de Produtores Rurais do Vale do Iuiu (CENTREVALE)» (14° 15' 42" S, 43° 21' 26" W, 488 m at sea level) in Palmas de Monte Alto, Bahia State

Abbreviations used: CT (conventional tillage), DAE (days after emergence), EMBRAPA (Empresa Brasileira de Pesquisa Agropecuaria), RT (reduced tillage).

(Brazil) during the agricultural year 2003-2004. According to the Köppen classification, the climate of this region is Aw. The yearly average temperature is 24°C and the annual average rainfall is 750 mm. During the reported agricultural year, total annual rainfall was 905.5 mm.

Soils at the site were classified as Eutrochrept (Soil Survey Staff, 2006). Textural analysis showed that the soil presented 250 g kg^{-1} sand, 360 g kg^{-1} silt and 390 g kg^{-1} clay in the 0 to 20 cm layer. Fertilization was carried out considering a soil chemical analysis: 6.7 pH in KCl, 24 mg dm^{-3} P, 50 $mmol_c$ dm^{-3} K^+, 231 $mmol_c$ dm^{-3} Ca^{+2}, 21.5 $mmol_c$ dm^{-3} Mg^{+2}, 5.8 $mmol_c$ dm^{-3} $H^+ + Al^{+3}$, 0.0 $mmol_c$ dm^{-3} Al^{+3}, and 92.45% of base saturation.

The experimental design was a split-plot arrangement in randomised blocks with four replications. The treatments in the main plots were two tillage systems: conventional tillage (CT) and reduced tillage (RT). The treatments in the subplots were four cotton cultivars: 'BRS Aroeira', 'BRS 201', 'Delta Opal' and 'BRS Cedro'. Thus, a total of eight treatments (each combination of a tillage system and a cotton cultivar) were established. Each experimental plot measured 200 m^2 (10 × 20 m, width and length, respectively), including 20 planting lines 1 m spaced. Each subplot measured 120 m^2 (6 × 20 m, width and length, respectively), including 6 planting lines 1 m spaced and a useful area of 60 m^2 (6 × 10 m, width and length, respectively). Blocks and plots were separated by 2 m width pathways.

All cotton cultivars used were developed by the Brazilian Enterprise for Agricultural Research (Empresa Brasileira de Pesquisa Agropecuaria, EMBRAPA) except the Delta Opal cultivar which was developed by Delta and Pine Land Company International from crossing American and Australian cultivars.

Conventional tillage was undertaken using a heavy-disc harrow followed by passes with a light-disc harrow. For reduced tillage, a chisel plow was used with a rototiller which consisted of seven parabolic tines followed by passes with a light-disc harrow. All plots received the same fertilization, 68 kg ha^{-1} P_2O_5 and 16 kg ha^{-1} N. Sowing was performed on 18th December 2003, at 3 cm depth, using 20 seeds m^{-1} and, at 30 days after plant emergence (DAE), the number of plants was set to 10 plants m^{-1}. Planting was performed manually both in CT and RT, distributing two seeds each 10 cm of the planting line. Soil was dry at the moment of planting.

During the study period, 12 insecticide applications were performed in order to control pests. These applications were carried out weekly between the 3 and 102 DAE. In order to control weeds, three manual controls were carried out at 8, 28 and 58 DAE.

In order to describe the growing patterns of the different cotton cultivars under each tillage management, five plants per plot were randomly selected. The height of these five identified plants per plot was measured at 6, 13, 20, 27, 34, 52, 69, 86 and 101 DAE. Plant height was considered as the distance from the soil to the apical meristem. Growth patterns were evaluated by the fitting of non-linear functions. Several asyntotic functions are considered adequate to describe this process (Richards, 1959; Nelder, 1961; Amabile *et al.*, 2003). The choice of the model was based on previous plotting analysis. Data obtained were fitted to a logistic function described by Amabile *et al.* (2003):

$$\omega = \frac{\theta}{\left(1 + \exp^{\alpha - \beta \cdot X}\right)}$$

where ω is the plant height, θ is the plant height at physiological maturity, α is a location parameter, β is the growth expansion rate and X is the time. For computing the inflection time, the relation α/β was used.

Stem diameter at 10 cm above the rootstalk was measured at 145 DAE using a caliper.

To determine fiber physical characteristics, 20 bolls per plot were randomly hand-harvested from the top of the plants. Fiber properties of each sample were determined in high volume instruments (HVI) at the EMBRAPA Laboratory of Fiber Technology. The properties analyzed were: (a) fiber percentage (ratio between average fiber weight and cotton weight), (b) average fiber length in millimeters, (c) fiber resistance as the force (g tex^{-1}) to break the fiber bundle (a tex unit is equal to the weight in grams of 1000 m of fibers), (d) length uniformity of fiber, (e) percentage of short fibers, (f) micronaire reading (μg in^{-1}) as fineness of the fiber (micronaire is actually equal to the average weight of the fiber in micrograms).

Hand harvesting was carried out at 145 DAE. Statistical analyses were performed using SISVAR software (Ferreira, 2000). Tukey test at 5% of significance was used for mean comparison.

Results

Logistic curves were fitted to the growth patterns of all the cultivars (Fig. 1). Determination coefficients (r^2) were greater than 0.9 in all cases. BRS Cedro and BRS Aroeira achieved greater plant height under RT

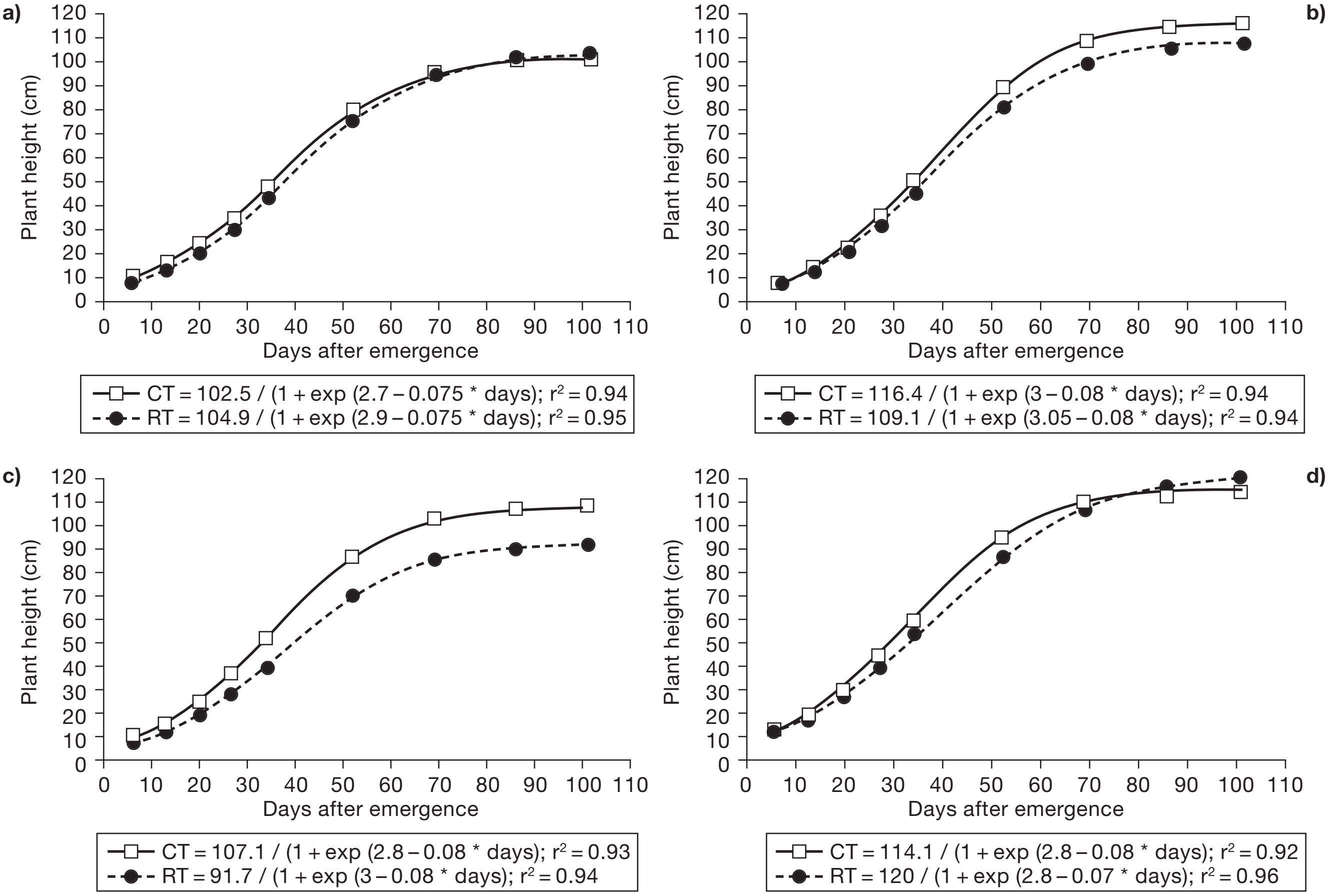

Figure 1. Growth curves and logistic equations fitted to them for the cotton cultivars considered as a function of soil tillage systems (CT: conventional tillage; RT: reduced tillage): a) BRS Aroeira, b) BRS 201, c) Delta Opal, d) BRS Cedro.

than CT while the opposite was true for BRS 201 and Delta Opal cultivars (Fig. 1). BRS Aroeira exhibited similar trend on growth curves under the two tillage systems (Fig. 1a), whereas the Delta Opal cultivar was greatly affected by tillage systems and its plant height was higher under CT (Fig. 1c). BRS Cedro showed a more rapid growth pattern under CT than under RT. However, it reached a greater plant height under RT (Fig. 1d).

All cultivars needed more time to reach the inflection point of the growth curve under RT than under CT (Table 1). However, this difference was significant only for BRS Cedro. The cultivar BRS 201 under RT needed 41.48 days to reach the inflection point, whereas BRS Cedro under CT needed only 34.23 days to reach the inflection point (Table 1). There were no significant differences for reaching this inflection point between cultivars within each tillage system.

No significant difference was observed on plant height at maturity between tillage systems, the averages being 109.51 cm for CT and 106.84 cm for RT (Table 1). BRS Cedro cultivar obtained the greatest plant heights: 114.13 cm under CT and 120.78 m under RT. Under CT, no significant differences were observed among cultivars. Under RT, Delta Opal showed the lowest plant height. Comparing the different cultivars under each tillage system, the rank order of plant growth under CT was BRS Cedro > BRS 201 > Delta Opal > BRS Aroeira. In the case of RT, the order was BRS Cedro > BRS 201 > BRS Aroeira > Delta Opal (Table 1).

Stem diameters of cotton plants were not significantly affected by tillage system. There were no differences between cultivars for this characteristic (Table 1). However, stem diameter were slighty greater under CT than under RT.

Boll average weight was not influenced by tillage systems for any studied cultivar (Table 2). However, greater boll weights were observed under CT, except for BRS Cedro. Comparing cultivars, BRS Aroeira had the highest and BRS 201 the lowest boll weights.

Table 1. Inflection point, plant height and stem diameter average values as a function of tillage systems and cotton cultivars

Cultivars	Soil tillage systems		
	Conventional	Reduced	Averages
Inflection point (days)			
BRS Aroeira	35.98 (± 2.04)^{Aa}	41.08 (± 5.35)^{Aa}	38.53^{a}
BRS 201	36.37 (± 3.50)^{Aa}	41.48 (± 4.32)^{Aa}	38.92^{a}
Delta Opal	34.47 (± 1.59)^{Aa}	38.37 (± 3.37)^{Aa}	36.42^{a}
BRS Cedro	34.23 (± 1.45)^{Ba}	39.93 (± 3.04)^{Aa}	37.08^{a}
Averages	35.26^{B}	40.21^{A}	
Plant height at maturity (cm)			
BRS Aroeira	103.41 (± 7.59)^{Aa}	104.67 (± 6.98)^{Aab}	104.04^{ab}
BRS 201	113.46 (± 17.85)^{Aa}	108.16 (± 12.47)^{Aab}	110.8^{ab}
Delta Opal	107.05 (± 12.44)^{Aa}	93.75 (± 8.973)^{Ab}	100.39^{b}
BRS Cedro	114.13 (± 9.33)^{Aa}	120.78 (± 7.96)^{Aa}	117.45^{a}
Averages	109.51^{A}	106.84^{A}	
Stem diameter (cm)			
BRS Aroeira	1.11 (± 0.11)^{Aa}	1.13 (± 0.06)^{Aa}	1.12^{a}
BRS 201	1.13 (± 0.06)^{Aa}	1.04 (± 0.10)^{Aa}	1.08^{a}
Delta Opal	1.18 (± 0.16)^{Aa}	1.03 (± 0.10)^{Aa}	1.11^{a}
BRS Cedro	1.21 (± 0.12)^{Aa}	1.19 (± 0.07)^{Aa}	1.20^{a}
Averages	1.16^{A}	1.09^{A}	

Means followed by the same letter (small in columns and capital in rows) are non-significant according to Tukey test, $p = 5\%$.

No significant differences were observed for cotton yield average values between tillage systems. However, Delta Opal and BRS Cedro had 17% and 11%, respectively greater yields under CT than under RT (Table 2).

Under CT, BRS Cedro attained the highest fiber percentage, significantly different from the rest of the cultivars. BRS Aroeira presented the lowest fiber percentage in both treatments and differed from Delta Opal and BRS Cedro. Under RT, BRS Cedro and Delta Opal showed the highest fiber percentage, significantly different from the other two cultivars (Table 2). The rank order was BRS Cedro (43.73%), Delta Opal (41.66%), BRS 201 (39.33%) and BRS Aroeira (37.76%).

The four cultivars used in this experiment are considered medium fiber varieties (28-32 mm). BRS 201 cultivar showed the lowest fiber length under RT (29.42 mm), being significantly different from the value obtained under CT (30.45 mm). However, no significant differences were observed among cultivars (Table 3). Uniformity of length indicates the presence of shorter fibers. Tillage systems affected fiber uniformity of BRS 201, being higher under CT (84.68%) than under RT (83.40%). No significant differences were observed among cultivars.

Micronaire values were significantly different for the Delta Opal cultivar under the two tillage systems, RT promoted higher values than CT (Table 3). No significant differences were observed on the average values of this index between cultivars. However, BRS 201 showed a significantly greater micronaire value than Delta Opal under CT.

Under CT, fiber resistance values were higher than under RT, except for BRS 201 which did not present significant differences between tillage systems (Table 4). Under CT, Delta Opal showed the highest value of fiber resistance, being significantly different than that of BRS 201. Under RT, BRS Aroeira cultivar presented the lowest values of fiber resistance, being significantly different from that of the other cultivars considered.

No significant differences were observed for the percentage of short fibers (Table 4).

Discussion

This study examined the effect of two tillage systems on several characteristics of four cotton cultivars in an important production area in Brazil.

Table 2. Boll weight, cotton yield and fiber percentage average values as a function of tillage systems and cotton cultivars

Cultivars	Soil tillage systems		
	Conventional	Reduced	Averages
Boll weight (g)			
BRS Aroeira	5.90 (± 0.20)[Aa]	5.83 (± 0.13)[Aa]	5.86[a]
BRS 201	5.53 (± 0.29)[Ab]	5.45 (± 0.19)[Aab]	5.49[b]
Delta Opal	5.78 (± 0.21)[Aab]	5.70 (± 0.14)[Aab]	5.74[ab]
BRS Cedro	5.65 (± 0.13)[Aab]	5.78 (± 0.13)[Aab]	5.71[ab]
Averages	5.71[A]	5.69[A]	
Cotton yield (kg ha^{-1})			
BRS Aroeira	2,953.85 (± 192.19)[Ab]	2,972.60 (± 339.51)[Aa]	2,963.23[ab]
BRS 201	3,312.23 (± 262.75)[Aab]	3,043.68 (± 182.71)[Aa]	3,177.95[ab]
Delta Opal	3,556.78 (± 329.30)[Aa]	3,035.30 (± 465.98)[Ba]	3,296.04[a]
BRS Cedro	3,120.53 (± 97.89)[Aab]	2,746.43 (± 222.33)[Ba]	2,933.48[b]
Averages	3,235.84[A]	2,949.50[A]	
Fiber percentage			
BRS Aroeira	38.40 (± 0.92)[Ac]	37.12 (± 0.80)[Ab]	37.76[d]
BRS 201	39.88 (± 0.50)[Abc]	38.78 (± 0.62)[Ab]	39.33[c]
Delta Opal	41.18 (± 1.13)[Ab]	42.15 (± 1.35)[Aa]	41.66[b]
BRS Cedro	43.88 (± 0.77)[Aa]	43.57 (± 0.57)[Aa]	43.73[a]
Averages	40.83[A]	40.41[A]	

Means followed by the same letter (small in columns and capital in rows) are non-significant according to Tukey test, $p = 5\%$.

The growth patterns of the studied cotton cultivars as described by logistic equations showed symmetric distributions independently of the treatment. This result is in accordance with the finding by Amabile *et al.* (2003), who selected this type of equation as the most adequate model for describing sunflower growth patterns.

Plant height results were in accordance with those found by Lamas *et al.* (2003) who evaluated different cotton genotypes in the state of Mato Grosso do Sul (Brazil). They observed that the BRS Cedro cultivar was the tallest among the commonly cultivated cultivars in the region. The results of the current study showed no significant differences between tillage systems for plant height.

The inflection point of the growth curve represents half of the plant height at physiological maturity, so it indicates the velocity of growth. The results from the current study indicated that tillage system influenced this trait. Under CT, cotton plants needed a shorter time to reach the inflection point. However, this difference was only significant for BRS Cedro.

Tillage system did not affect boll weight. Farias *et al.* (1999) suggested a value of 6 g as a desirable weight for hand-harvesting. In the present study, all the cultivars presented boll weights close to this threshold.

Reports on the effect of tillage on cotton yield are varied; some researchers obtaining higher yields in conservation than in conventional till (Smith, 1995; Nyakatawa and Reddy, 2000; Boquet *et al.*, 2004), while others observing higher yields in conventional till than in no-till (Ishaq *et al.*, 2001; Ozpinar and Isik, 2004). No significant differences between tillage systems were detected during the current study, which is in conformity with the results of Stevens *et al.* (1992) and Daniel *et al.* (1999) in other countries. Cultivar performance is affected by the climatic conditions. Delta Opal cultivar showed the best performance in this study in line with the findings of Pedrosa *et al.* (2007) in the state of Bahia (Brazil). In contrast, Freire *et al.* (2005) found that the BRS Cedro cultivar produced the highest yields in the Brazilian Cerrado and Ribeiro *et al.* (2005) observed the highest yields for the BRS Aroeira cultivar in the South West of the Piaui State in Brazil.

The fact that cotton yields did not differ between CT and RT is in accordance with the earlier findings on this site by Fernandes *et al.* (2007). This seems to indicate that both tillage systems are adequate for cotton cultivation in this region; although RT is recommended for the sake of sustainability.

Table 3. Fiber length, uniformity of length and micronaire index average values as a function of tillage systems and cotton cultivars

Cultivars	Soil tillage systems		
	Conventional	Reduced	Averages
Fiber length (mm)			
BRS Aroeira	30.83 (±0.83)^{Aa}	30.35 (±0.48)^{Aa}	30.59^{a}
BRS 201	30.45 (±0.29)^{Aa}	29.42 (±0.25)^{Ba}	29.94^{a}
Delta Opal	30.35 (±0.66)^{Aa}	29.77 (±0.84)^{Aa}	30.06^{a}
BRS Cedro	29.75 (±1.03)^{Aa}	29.95 (±0.29)^{Aa}	29.85^{a}
Averages	30.34^{A}	29.88^{A}	
Uniformity of length (%)			
BRS Aroeira	83.93 (±0.99)^{Aa}	83.45 (±0.75)^{Aa}	83.69^{a}
BRS 201	84.68 (±0.53)^{Aa}	83.40 (±0.94)^{Ba}	84.04^{a}
Delta Opal	85.17 (±0.73)^{Aa}	84.05 (±0.90)^{Aa}	84.65^{a}
BRS Cedro	84.63 (±0.75)^{Aa}	84.63 (±0.56)^{Aa}	84.63^{a}
Averages	84.06^{A}	83.88^{B}	
Micronaire index			
BRS Aroeira	4.23 (±0.21)^{Aab}	4.48 (±0.26)^{Aa}	4.35^{a}
BRS 201	4.53 (±0.32)^{Aa}	4.48 (±0.13)^{Aa}	4.50^{a}
Delta Opal	3.90 (±0.08)^{Bb}	4.43 (±0.13)^{Aa}	4.16^{a}
BRS Cedro	4.18 (±0.21)^{Aab}	4.48 (±0.39)^{Aa}	4.33^{a}
Averages	4.21^{B}	4.46^{A}	

Means followed by the same letter (small in columns and capital in rows) are non-significant according to Tukey test, $p = 5\%$.

Table 4. Fiber resistance and percentage of short fibers average values as a function of tillage systems and cotton cultivars

Cultivars	Soil tillage systems		
	Conventional	Reduced	Averages
Fiber resistance (gf tex^{-1})			
BRS Aroeira	31.78 (±2.02)^{Aab}	24.85 (±1.42)^{Bb}	28.31^{b}
BRS 201	30.40 (±2.92)^{Ab}	29.90 (±2.05)^{Aa}	30.15^{ab}
Delta Opal	34.30 (±1.07)^{Aa}	28.50 (±1.23)^{Ba}	31.40^{a}
BRS Cedro	33.38 (±1.52)^{Aab}	29.90 (±1.06)^{Ba}	31.63^{a}
Averages	32.46^{A}	28.28^{B}	
Percentage of short fibers			
BRS Aroeira	3.73 (±0.35)^{Aa}	3.95 (±0.90)^{Aa}	3.84^{a}
BRS 201	3.25 (±0.29)^{Aa}	3.75 (±0.35)^{Aa}	3.50^{a}
Delta Opal	3.55 (±0.49)^{Aa}	3.93 (±1.27)^{Aa}	3.74^{a}
BRS Cedro	3.65 (±0.60)^{Aa}	3.60 (±0.86)^{Aa}	3.63^{a}
Averages	3.54^{A}	3.81^{A}	

Means followed by the same letter (small in columns and capital in rows) are non-significant according to Tukey test, $p = 5\%$.

Concerning the fiber quality properties, the studied cultivars differed significantly in fiber percentage. According to Farias *et al.* (1999), a satisfactory percentage of fibers is that of 40% or greater. In the current work, BRS Cedro and Delta Opal presented values over this threshold. However, the other two cultivars studied showed values of percentage of fibers close to this threshold, although slightly lower. Lamas *et al.* (2003) also found higher fiber percentages for the BRS Cedro cultivar.

From a comercial viewpoint, the most important characteristic of cotton is the average length of the fibers. According to the EMBRAPA Laboratory of Fiber Technology, fibers shorter than 28 mm are considered as to have a low comercial value. Results from this study showed that the four cultivars considered presented fibers longer than 28 mm, thus, they are considered as profitable cultivars. Moreover, satisfactory values of uniformity of length of cotton fibers are those between 83% and 85% (Santana *et al.*, 1999), thus the evaluated cultivars showed uniform fibers.

Desirable micronaire values range between 3.5 and 4.2 (Santana *et al.*, 1999). The cultivars considered in this study showed values close to or within this range. Under CT, BRS 201 and BRS Aroeira presented values above this range whereas, under RT, all the cultivars presented micronaire values slightly greater than the desired threshold.

Another important parameter of cotton quality is the fiber resistance, which is directly affected by the main characteristics of the fibers (Santos, 1997). The Brazilian textile industry requires fiber resistances above 24 gf tex^{-1}. All the cultivars considered in the current study showed values above this threshold. However, under RT, this trait was significantly lower than under CT.

The percentage of short fibers is the ratio between fibers shorter than 12.7 mm and the mass. Values lower than 7% are desired. In this case, all the cultivars presented low values for this trait. No significant differences were detected between tillage systems.

In summary, only four traits differed between tillage systems: inflection point, uniformity of length of the fibers, micronaire index and fiber resistance. The BRS Cedro cultivar always showed the greatest plant height. CT induced longer and more uniform fibers on the BRS 201 cultivar, and a greater fiber resistance on BRS Aroeira, Delta Opal and BRS Cedro cultivars. However, RT promoted higher micronaire index values for Delta Opal.

The results of the study suggest that RT can be established in the region because it does not compromise cotton yields and fiber quality and allows a sustainable soil management. As the data presented here are from one year study, extrapolation of these results is difficult, but forms a sound base for further comprehensive and long-term studies.

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