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Nitrogen fertilization on cotton cropped under straw formed by seed proportions of crotalaria and brachiaria

Adubação nitrogenada no algodoeiro sobre palhada formada por proporções de sementes de crotalária com braquiária[1]

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Abstract

No-tillage cotton production system, using association of leguminous and grasses plants as cover crop, has benefits such as soil protection and increased nitrogen fertilization by biological nitrogen fixation. The present study aimed at evaluating if straw formed by seed proportion of *Crotalaria spectabilis* and *Urochloa ruziziensis* increases the total nitrogen contend in mulching and minimize nitrogen fertilization on cotton. The experiments followed a randomized block in split-plot design. In plots *Urochloa ruziziensis* associated with proportions of *Crotalaria spectabilis* seeds (0:8, 8:8, 12:8, 16:8 and 20:8 kg ha^{-1} of seeds) were sown, and in subplots were used four doses of nitrogen (0, 40, 70, and 110 kg ha^{-1} of N, source urea) applied as side dressing. The straw of different quantities of *Crotalaria spectabilis* associated with *Urochloa ruziziensis* do not interfere with phytomass yield and N contend. The nitrogen rates do not impact leaf nitrogen, number of bolls per plant and seed cotton and fiber yield.

Additional keywords: carbon:nitrogen ratio; *Crotalaria spectabilis; Gossypium hirsutum* L. r. *latifolium*; no-tillage system; *Urochloa ruziziensis*.

Resumo

No sistema plantio direto do algodoeiro, a associação de gramíneas e leguminosas como espécies de cobertura para a formação de palha possibilita a proteção do solo e o aporte de nitrogênio via fixação biológica. O objetivo do trabalho foi investigar se a palhada formada por proporções de sementes de *Crotalaria spectabilis* em relação à *Urochloa ruziziensis* melhora o conteúdo de nitrogênio total na matéria seca residual e se isto interfere na adubação nitrogenada do algodoeiro. Os experimentos foram dispostos no campo em esquema de parcela subdividida, com *Urochloa ruziziensis* associada a diferentes proporções de sementes de *C. spectabilis,* em relação a *U. ruziziensis* (0:8; 8:8; 12:8; 16:8 e 20:8 kg ha^{-1} de sementes). Nas subparcelas, foram aplicadas quatro doses de nitrogênio em cobertura (0; 40; 70 e 100 kg ha^{-1} de N), utilizando como fonte a ureia. Pode-se concluir que o aumento na proporção de sementes de *Crotalaria spectabilis,* em reação à *Urochloa ruziziensis*, não interfere na produção de fitomassa total de cobertura e no conteúdo de nitrogênio da palhada. As doses de nitrogênio aplicadas em cobertura não influenciaram sobre o teor foliar de N, o número de capulhos por planta e as produtividades de algodão em caroço e fibra, nas condições estudadas.

Palavras-chave adicionais: *Crotalaria spectabilis*; *Gossypium hirsutum* L. r. *latifolium*; relação carbono:nitrogênio; sistema plantio direto; *Urochloa ruziziensis.*

Introduction

The national cotton production, approximately 94% of the cropped area, is concentrated in cerrado (Conab, 2014). For the maintenance of productive sustainability of this biome were necessary soil chemical correction and replacement of conventional soil management for no-tillage system (NTS), consisting of the soil cover maintenance, no-tillage and crop rotation.

In NTS with cotton crop composing the rotation scheme, it has been a great challenge to maintain the straw in the soil throughout the cycle, because culture can stay on the field for 200 days (Ferreira et al., 2010). In this situation, the persistence of straw on the soil surface should be high, so that the benefits of coverage are achieved. In the choice of cover crops to form straw, it should be considered the persistence of biomass on soil, ability to provide nutrients to crops and effects of this species on insect pests and diseases presents in the production system.

The cultivation of *Urochloa ruziziensis* (Syn. *Brachiaria ruziziensis*) for ground cover and no-tillage of cotton has been a good alternative, especially since this species is easy to chemical control, reduces weed infestation and produces enough dry matter that remains persistent during the cotton cycle (Ferreira et al., 2010; Ferreira & Lamas, 2010). However, when cotton is grown after the grasses whose residues left on the soil have high carbon: nitrogen ratio (C:N), N deficiency may occur due to immobilization of the N-inorganic microbial biomass (Carvalho et al., 2011) and, if N is not available, it can harm the crop's initial development of culture. This fact justifies to anticipate the first top coverage with this nutrient, traditionally performed at the stage B1 - first flower bud (Marur & Ruano, 2001), in order to avoid the nitrogen deficiency and stimulate vegetative growth (Carvalho et al., 2011) or even increase the levels of nitrogen commonly used.

Overall, cotton is one of the crops of lowest efficiency in the use of nitrogen fertilizers (44%), i.e. this finding reveals the need to improve the use efficiency by the crop (Cunha et al., 2014), and also to rethink the rotation system. Many productive areas of cerrado have had problems with nematodes, and *Crotalaria spectabilis* has been used to reduce the population of *Meloidogyne incognita*, *Rotylenchulus reniformis* and *Pratylenchus brachyurus (*Inomoto & Asmus, 2014; Asmus et al., 2011). However, for providing low dry matter with composition of low C:N ratio and loads of soluble compounds, it shows rapid decomposition and mineralization (Zotarelli, 2000), and therefore it does not allow adequate coverage and soil protection. However, there is larger N input in the system with the introduction of this leguminous by biological nitrogen fixation (BNF) (Perin et al., 2003) and there are no reports to Cerrado region regarding the reduction of nitrogen fertilization being possible in the cotton in subsequent cultivation.

The association of grasses and legumes can offer two benefits, protecting the soil and adding N to the system (Bortolini et al., 2000), since it allows the production of dry biomass with high C:N ratio - greater than 30 (grassy) and low C:N ratio - less than 20 (leguminous), allowing C:N ratio close to the balance between immobilization and mineralization (Moreira & Siqueira, 2006; Amado et al., 2000), so that the rate of decomposition of plant residues is not so high, and the N supply to the commercial crop is not low, as would be only with the use of grass (Aita & Giacomini, 2003). The hypothesis would be that the straw left by the association between grasses and legumes could change the dynamics of nitrogen and allow the fertilization reduction of cotton coverage grown subsequently.

The objective was to investigate whether the increase in the proportion of *C. spectabilis* to *U. ruziziensis* seeds improves the total nitrogen content of the residual straw and if it interferes with the nitrogen fertilization of cotton.

Material and methods

The experiments were conducted under field conditions during seasons 2010-2011 (experiment 1) and 2011-2012 (experiment 2) in the experimental area of Fundação Goiás in Santa Helena de Goiás, Brazil (17°50'28''S 50°36'05''W; 552 m in altitude) in soil rated as tropical Oxisol (Red Latosol) (Embrapa, 2006). Prior to the experiments, soil samples were collected in the area from layers 0 to 10 and 10 to 20 cm deep, whose chemical properties are shown in Table 1.

According to Köppen's classification, the climate is Aw, with average annual rainfall of less than 2,000 mm, concentrated from October to March. Precipitation and maximum and minimum temperatures recorded in the experimental area during the experimental period are shown in Figure 1.

The experiments were conducted in the design of randomized blocks in split plot design with four replications. In the main plots were arranged the winter crop treatments consisting of *U. ruziziensis* associations, 8 kg ha^{-1} seeds with different proportions of *C. spectabilis* seeds for *U. ruziziensis* (0:8, 8:8, 12:8, 16:8 e 20:8 kg ha^{-1} seeds). In the subplots, with the cotton crop sown subsequently, were placed four nitrogen doses applied as side dressing (0, 40, 70 and 100 kg ha^{-1} N) using urea as source, being divided into two applications in continuous line on the plants side.

Table 1 - Chemical properties of soil at 0-10 cm and 10-20 cm deep, prior to the experiment. Santa Helena de Goiás, Brazil, season 2010-2011.

Depth	Soil chemical properties									
	(1)pH	(2)P	(3)K	(4)Ca	(5)Mg	(6)H+Al	(7)SB	(8)CEC	(9)V	(10)M.O.
(cm)	$CaCl_2$	(mg dm^{-3})	---------------------(mmol$_c$ dm^{-3})---------------------						------(%)------	
0 - 10	5.6	76.9	3.7	34.8	12.7	32.8	51.2	84.3	61	3.1
10 -20	5.5	53.7	3.5	29.9	10.5	36.2	43.8	80.1	54	3.0

(1) pH in $CaCl_2$ in soil:water ratio 1:2,5; (2) available phosphorus (P-resin); (3) potassium; (4) calcium; (5) magnesium; (6) exchangeable acidity; (7) total of bases = Ca+Mg+K; (8) cation exchange capacity = H+Al+SB; (9) base saturation= SB/CTC and (10) organic matter. Methods: P, K, Ca and Mg – extraction by ion exchange resin; M.O. – Dichromate/colorimetry (Embrapa, 1999).

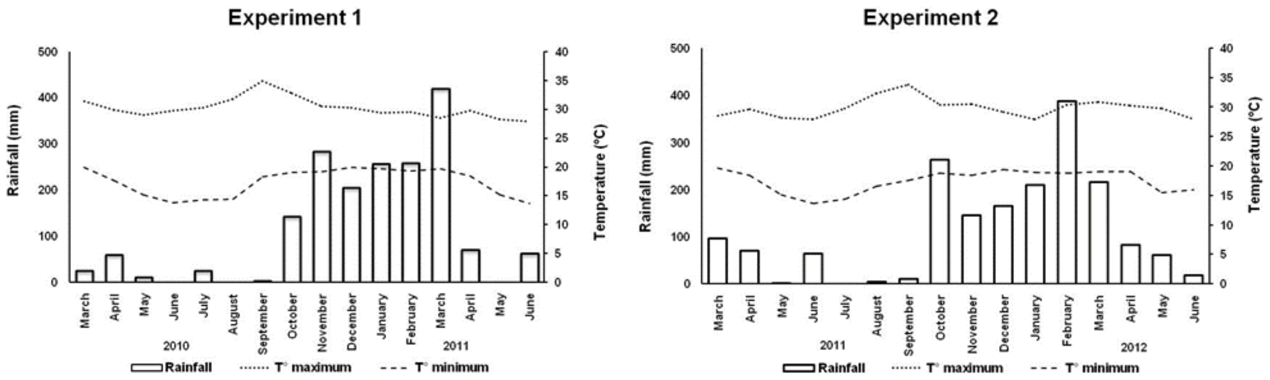

Figure 1 - Monthly rainfall (mm) and average monthly maximum (T° maximum) and minimum (T° minimum) temperatures during experiments 1 (2010-2011) and 2 (2011-2012).

Prior to installation of the two experiments, the BRS Favorita soybean cultivar was sown. Seeds were submitted to inoculation with *Bradyrhizobium* spp. to ensure at least 1.2 million viable cells per seed (Embrapa, 2008). The two experiments were conducted in adjacent areas.

The seeds' cultural value of *Urochloa ruziziensis* and *Crotalaria spectabilis* were 70 and 71, respectively. The *U. ruziziensis*, in the amount of 8 kg ha^{-1}, was seeded single or associated with *Crotalaria spectabilis*, after soybean harvest, on 03-10-2010 in experiment 1 and on 03-21-2011 in experiment 2, without sowing fertilization in plots of 10 m x 10 m. The spacing between rows was 0.45 m. In the plots with association between *U. ruziziensis* and *C. spectabilis*, seeds were mixed and the sowing performed at the same depth and row. Crotalaria seeds were not treated with inoculants. During the growth phase of cover crops, no interventions for control of weeds were performed. In November, plots with *U. ruziziensis,* single or associated with *C. spectabilis,* were sampled from three points of 0.25 m^2 and the plant material was cut close to the ground. Samples were separated and dried in forced-air oven at 65 °C until constant mass to quantify the dry matter of shoots in both species separately. Subsequently, the nitrogen content was determined in each of them and the accumulation of total nitrogen was obtained by the product of dry matter with the N content of each of them. The N content of straw was obtained by the sum of contents of *U. ruziziensis* and *C. spectabilis*

The species were desiccated on 11-27-2010 in experiment 1, and on 12-06-2011 in Experiment 2, using 1.680 g ha^{-1} of the active ingredient glyphosate.

Each subplot was formed by six lines of BRS 293 cotton crop in spacing of 0.80 m between rows and 4.5 m in length, being the four central rows considered useful plot. The cotton sowing was carried out on 12-16-2010 and 12-23-2011 in experiments 1 and 2, respectively, with a density of 9 plants per meter and application of 450 kg ha^{-1} of formulated 4-30-16 + 0.5% Zn + 0.4% B in the sowing furrow.

In experiment 1, the first nitrogen fertilization was performed at 40 days after emergence (dae) with half the dose and the second at 63 dae with the other half. In experiment 2, the first nitrogen fertilization was performed at 31 dae (B1 – first flower bud in the first sympodial branch) with half the dose and the second at 60 dae (F1 - first open flower) with the other half. Additionally, side dressing potassium chloride fertilization was performed in all subplots.

In both experiments at 80 dae (F8 – first open flower in the eighth sympodial branch) in the full bloom, cotton plant leaves (fourth leaf from the apex of the main stem) were collected in 15 plants per subplot. The leaves were placed in paper bags and dried in a forced-air oven at 65 °C for 72 hours, milled and subjected to nitrogen analysis (Malavolta et al., 1997).

At harvest (complete defoliation and all open bolls), final plant height, number of bolls per plant (NBP), in five plants collected in useful plot, and seed cotton and lint yield was evaluated. Fiber samples were taken from twenty plants for measure cotton fiber properties (length, uniformity, short fiber index, strength, elongation, micronaire or fineness, maturity, reflectance, yellowness) through the equipment of High Volum Instrument (HVI). Collected data were analyzed separately for each crop year, regardless of the year factor in the analysis. Data were submitted by analysis of variance (F-test, $Pr<0.05$) and regression analysis.

Results and discussions

The dry matter of *C. spectabilis* increased linearly with increasing seed ratio per hectare ($Y = 11.9 + 46.9^{**}x$; $R^2 = 93.18\%$), unlike what happened with the *U. ruziziensis* (Table 2). Despite being associated, species were separated in harvest for measuring the dry matter and N content. If total dry matter is considered, there was no influence of the leguminous presence on increased biomass production, this because the average dry matter of *U. ruziziensis* was at least 10 times higher that of leguminous in plots of association (Table 2). The grass showed rapid establishment and rapid growth rate, even in plots with higher proportion of crotalaria seeds. This behavior was also observed by Heinrichs and Fancelli (1999) in an experiment using association between grasses and legumes, whose grass showed higher biomass production.

The lack of response of the N content of *Urochloa ruziziensis* to the increased quantity of *Crotalaria spectabilis* seeds in association can be explained by the weak effect of BNF, depending on the existing competition between grass and leguminous for light, because there was less production of biomass from *C. spectabilis* relative to *U. ruziziensis* (Table 2). Perin et al. (2003) confirmed that *C. juncea* was able to incorporate 89 kg ha^{-1} of N into the soil via BNF, when associated with millet, and under experimental conditions *C. juncea* had the highest growth competitiveness with millet, due to the higher biomass production, about 31% higher than millet. Heinrichs and Fancelli (1999) found no difference in the levels of nitrogen when the vetch leguminous was associated with oats, regardless of proportion. Similarly, there was no significant difference in total N content of straw from the association with more or less participation of crotalaria (Table 2). Alves et al. (2006) found negative balance of N or near neutrality after the cultivation of soybeans, i.e. BNF is sufficient to ensure high productivity and demand just for itself. That is, the idea of introducing a leguminous in the production system to increase the N input can not be so simple, especially when there is the combination of legumes with more aggressive growing species such as grasses.

Table 2 - Dry matter of *Crotalaria spectabilis* (CRO) and single *Urochloa ruziziensis* (URO) ; *U. ruziziensis* associated with *C. spectabilis* (TOTAL DM), nitrogen content and total nitrogen content in the straw of *U. ruziziensis* and *C. spectabilis* (Total nitrogen contet).

Treatments	Dry matter			Nitrogen content		Total nitrogen content
	CRO	URO	TOTAL DM	CRO	URO	
	------------- (kg ha^{-1}) -----------			----- (g kg^{-1}) -----		--(kg ha^{-1})--
C. spectabilis (0 kg ha^{-1}) + *U. ruziziensis* (8 kg ha^{-1})	-	6.467	6.467	-	13.2	84.7
C. spectabilis (8 kg ha^{-1}) + *U. ruziziensis* (8 kg ha^{-1})	330	6.981	7.311	10.8	14.3	103.7
C. spectabilis (12 kg ha^{-1}) + *U. ruziziensis* (8 kg ha^{-1})	633	6.212	6.845	10.7	13.5	90.6
C. spectabilis (16 kg ha^{-1})+ *U. ruziziensis* (8 kg ha^{-1})	817	6.600	7.417	11.5	13.1	95.4
C. spectabilis (20 kg ha^{-1})+ *U. ruziziensis* (8 kg ha^{-1})	893	7.086	7.979	12.7	11.3	91.1
F test	*	ns	ns	ns	ns	ns
[(1)]CV (%)	21.0	9.6	8.9	15.0	9.3	14.0
Mean	668	6.669	7.204	11.4	13.1	93.1

[(1)] CV – coefficient of variation; ns - not significant at 5% probability by the F Test.

The interaction between the proportion of *C. spectabilis* seeds and nitrogen doses was not significant for any of the variables studied in cotton plants (Table 3).

In both experiments, the cotton yield and N leaf content in cotton were not influenced by the presence of crotalaria in association with grass (Table 3). According to Lange et al. (2009), nitrogen mineralization process of *C. juncea* was slow and represented less than 10% of total N for each year of cultivation. According to Ladd et al. (1983), the main benefit of incorporating legumes in the system is long-term by keeping organic nitrogen concentration to ensure future crops. Probably, the beneficial effect of the introduction of leguminous into system over time has been restricted to fall and legume leaf decomposition during the grass cycle, minimizing the potential contribution of N for cotton plant.

Another interesting fact is that even in the absence of *C. spectabilis*, i.e. straw of *U. ruziziensis*, cotton seed yield were relatively high in experiment 1, which shows that nitrogen supply to the culture was appropriate, i.e. N immobilization by straw did not promote nutritional deficiency in cotton plant (Table 3), which can be confirmed by the N leaf content that is within the desired range, which is 35 to 43 g kg^{-1} according to Silva and Raij (1996) and Malavolta (1987). Similarly, it is observed that even in the subplots without application of N, the yield obtained was high and there was no N deficiency in the leaves (Table 3), as part of N may have been from the mineralization of organic matter. However, high cotton yield with low doses of nitrogen can promote soil depletion over time, since the quantity exported by the harvest is greater than the amount added (Alves et al., 2006). According to Carvalho et al. (2011), the average N exported is 33.9 kg N for each ton of cotton seed produced. For cotton yields obtained in this experiment, overall average of 4.7 t of seed cotton, doses of nitrogen fertilizers used can result in a negative balance of nitrogen in soil.

In experiment 1 (2010-2011), the increase in nitrogen doses led to the linear increase of nitrogen concentration in leaves ($Y = 35.9 + 0.03^{**}x$; $R^2 = 86.29\%$). However, in experiment 2 (2011-2012), there was no significant difference; this fact can be explained by lower growth of cotton plants, causing the effect of nitrogen concentration in leaves, even at lower doses of N. Cotton plants of experiment 2 had a mean final height of 81.6 cm, below the average found in experiment 1, which was 116.8 cm, i.e. the cotton plants were 35.5 cm shorter, probably due to less water availability in the 2011-2012 season, which interfered in growth, seed cotton yield and conse-quently in nitrogen use efficiency. In experiments 1 and

2, the increase in nitrogen levels and increased proportion of crotalaria plants for *Urochloa ruziziensis* did not affect the number of bolls per plant, cotton seed and lint yield (Table 2). Ferreira et al. (2010) found no difference for yields of cotton plant grown over Crotalaria spectabilis straw compared to that cultivated on the straw of Panicum maximum cv. Mombaça and cv. Tanzania, which were the treatments with higher productivity. Part of the explanation could be in the fact that the use of the N by culture in succession will depend on the timing between the decomposition and mineralization of biomass from the previous crop and demand rate of the implanted culture (Amado et al., 2000).

Table 3 - Nitrogen content in the leaves (Foliar N), height of cotton plants at harvest time (Height), number of bolls per plant (NBP), and in-seed and fiber cotton yield, depending on the amount of seeds from *Crotalaria spectabilis* associated with *Urochloa ruziziensis* and nitrogen levels in coverage. Santa Helena de Goiás, Brazil, 2010-2011 and 2011-2012 seasons.

Treatments	Foliar N		Height		NBP		Yield			
							Cotton		Fiber	
	----- (g kg^{-1}) -----		------ (cm) ------				---- (kg ha^{-1}) ----		---- (kg ha^{-1}) ----	
Crotalaria seeds (C)	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012
0 kg ha^{-1}	36.8	49.9	117.6	78.9	11.5	6.8	4.876	1.896	2.119	848
8 kg ha^{-1}	37.3	51.2	117.0	81.6	10.5	7.1	4.814	2.320	2.133	1.033
12 kg ha^{-1}	38.6	53.1	118.3	81.2	13.1	6.9	4.814	2.333	2.110	1.044
16 kg ha^{-1}	37.3	50.3	115.6	80.2	10.7	7.0	4.644	2.340	2.040	1.052
20 kg ha^{-1}	37.0	49.1	115.5	84.5	12.0	7.5	4.524	2.362	1.979	1.066
F Test	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
(1)CV (%) 1	6.6	11.8	5.9	3.7	31.56	10.5	10.1	19.2	9.0	20.2
N doses (N)										
0 kg ha^{-1}	35.6	49.7	118.4	79.6	11.9	7.1	4.795	2.286	2.100	1.028
40 kg ha^{-1}	37.7	52.6	115.4	81.8	11.6	7.1	4.624	2.201	2.016	981
70 kg ha^{-1}	37.5	50.2	117.5	82.3	11.1	7.1	4.901	2.368	2.154	1.065
100 kg ha^{-1}	38.7	50.4	115.9	81.4	11.7	7.0	4.619	2.145	2.034	961
F test	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
(1)CV (%)	8.7	8.3	3.6	4.4	25.9	8.5	7.9	18.1	8.0	18.4
(C) x (N)	ns	ns	ns	ns	ns	ns	ns	ns	ns	s
Mean	37.4	50.7	116.8	81.3	11.6	7.1	4.735	2.250	2.076	1.009

(1) CV - coefficient of variation. Note: ns and * - not significant and significant, respectively, at 5% probability by the F Test.

Table 4 - Fiber's technological properties: length (UHM), uniformity (UNF), short fiber index (SFI), strength (STR), elongation (ELG), micronaire or fineness (MIC), maturity (MAT), reflectance (Rd), yellowness (+b) and reliability index (CSP) of BRS 370 RF cotton grown in straw of *Crotalaria spectabilis* associated with *Urochloa ruziziensis* and nitrogen doses in coverage. Santa Helena de Goiás, GO, average seasons 2010-2011 and 2011-2012

Treatments	Fiber's Technological characteristics									
	UHM 1	UNF 2	SFI 3	STR 4	ELG 5	MIC 6	MAT 7	Rd 8	+b 9	CSP 10
Crotalaria seeds (C)	(mm)	----- (%)	-----	(gf tex^{-1})	(%)	(µg pol^{-1})	----- (%)	-----		
0 kg ha^{-1}	28.49	84.35	7.40	28.98	6.59	4.81	0.87	70.93	7.79	2546
8 kg ha^{-1}	28.58	83.87	7.49	28.94	6.33	4.73	0.87	70.09	7.60	2514
12 kg ha^{-1}	28.71	84.35	7.15	29.91	6.36	4.76	0.87	71.16	7.80	2621
16 kg ha^{-1}	28.20	83.65	7.58	29.59	6.40	4.84	0.88	70.61	7.40	2489
20 kg ha^{-1}	28.16	83.92	7.48	28.96	6.61	4.77	0.87	69.90	7.45	2492
(1)CV (%)	3.0	1.4	13.1	5.4	7.1	5.4	0.7	1.5	6.0	10.1
F test	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
N doses (N)										
0 kg ha^{-1}	28.68	83.91	7.53	29.34	6.43	4.80	0.87	70.44	7.69	2534
40 kg ha^{-1}	28.09	83.89	7.41	28.84	6.31	4.75	0.87	70.66	7.50	2482
70 kg ha^{-1}	28.39	84.20	7.33	29.84	6.57	4.79	0.87	70.58	7.63	2580
100 kg ha^{-1}	28.55	84.11	7.39	29.07	6.51	4.80	0.87	70.47	7.61	2533
F test	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
(C) x (N)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
(1)CV (%)	2.4	1.2	9.4	6.2	8.3	4.0	0.7	1.9	6.0	7.5
Mean	28.43	84.03	7.41	29.27	6.46	4.78	0.87	70.54	7.61	2532

(1) CV - coefficient of variation. Note: ns - not significant at 5% probability by the F Test.

From the results, it was not possible to reduce the nitrogen fertilization in cotton plants even when used the highest proportion of *Crotalaria spectabilis* seeds relative to *Urochloa ruziziensis,* unlike the data presented by Zotarelli (2000) studying the effect of introducing legumes and subsequent corn crop.

Technological fiber characteristics evaluated in HVI were not influenced by the factors of this study in the experiments 1 and 2 (Table 4).

Conclusion

The straw formed by seed proportions of *Crotalaria spectabilis* and *Urochloa ruziziensis* does not change the total nitrogen content in the residual dry matter and therefore, it does not reduce the nitrogen fertilization to be applied in cotton plant.

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References

Aita C, Giacomini SJ (2003) Decomposição e liberação de nitrogênio de resíduos culturais de plantas de cobertura de solo solteiras e consorciadas. Revista Brasileira de Ciência do Solo 27(4):601-612.

Alves BJR, Zotarelli L, Fernandes FM, Heckler JC, Macedo RAT, Boddey RM, Jantalia CP, Urquiaga S (2006) Fixação biológica de nitrogênio e fertilizantes nitrogenados no balanço de nitrogênio em soja milho e algodão. Pesquisa Agropecuária Brasileira 41(3):449-456.

Amado TJC, Mileniczuk J, Fernandes SBV (2000) Leguminosas e adubação mineral para o milho em sistemas de preparo do solo. Revista Brasileira de Ciência do Solo 24(1):179-189.

Asmus GL, Inomoto MM, Silva RA, Galbieri R (2011) Manejo de nematoides In: Freire EC (Ed) Algodão no cerrado do Brasil, 2nd edn, ABRAPA. p.639-675.

Bortolini CG, Silva PR, Argenta G (2000) Sistemas consorciados de aveia preta e ervilhaca comum como cobertura de solo e seus efeitos na cultura do milho em sucessão. Revista Brasileira de Ciência do Solo 24(4):897.

Carvalho MCS, Ferreira GB, Staut LA (2011) Nutrição, calagem e adubação do algodoeiro. In: Freire EC (Ed) Algodão no cerrado do Brasil 2nd ed, ABRAPA. p.677--752.

Conab – Companhia Nacional de Abastecimento (2014) Acompanhamento da safra brasileira de grãos 2013/2014 Available at: <http://wwwconabgovbr/OlalaCMS/uploads/arquivos/14_06_10_12_12_37_boletim_graos_junho_2014pdf> (Acessed 08 jul 2014).

Cunha JF, Francisco EAB, Casarin V, Prochnow LI (2014) Balanço de nutrientes na agricultura brasileira – 2009 a 2012. 13p. IPNI, Available at <http://www.ipni.net/publication/ia-brasil.nsf/0/0FAA336F68608D3983257CB30071DE8C/$FILE/Page1-13-145.pdf> (acessed 15 aug 2014).

Embrapa – Empresa Brasileira de Pesquisa Agropecuária (2006) Sistema Brasileiro de Classificação de Solos 2nd edn. Embrapa Solos. 306p.

Embrapa – Empresa Brasileira de Pesquisa Agropecuária (1999) Manual de Análises Químicas de Solos Plantas e Fertilizantes. Embrapa Comunicação para Transferência de Tecnologia. 370p.

Embrapa – Empresa Brasileira de Pesquisa Agropecuária (2008) Tecnologias de produção de soja – Região Central do Brasil 2009 e 2010. Embrapa Soja/Embrapa Cerrados/Embrapa Agropecuária Oeste. 262p.

Ferreira ACB, Lamas FM (2010) Espécies vegetais para cobertura do solo: influência sobre plantas daninhas e a produtividade do algodoeiro em sistema plantio direto. Revista Ceres 57(6):778-786.

Ferreira ACB, Lamas FM, Carvalho MCS, Salton JC, Suassuna ND (2010) Produção de biomassa por cultivos de cobertura do solo e produtividade do algodoeiro em plantio direto. Pesquisa Agropecuária Brasileira 45(6):546-553.

Heinrichs R, Fancelli AL (1999) Influência do cultivo consorciado de aveia preta (*Avena strigosa* Schieb) e ervilhaca comum (*Vicia sativa* L) na produção de fitomassa e no aporte de nitrogênio. Scientia Agrícola 56(1):27-31.

Inomoto MM, Asmus GL (2014) Adubos verdes das famílias Fabaceae e Mimosaceae para controle de fitonematóides. In: Lima Filho OF, Ambrosano EJ, Rossi F, Carlos JAD (Eds) Adubação verde e plantas de cobertura no Brasil Fundamentos e Prática, Embrapa. p.441-479.

Ladd JN, Amato M, Jackson RB, Butler JHA (1983) Utilization by wheat crops of nitrogen from legume residues decomposing in soils in the field. Soil Biology & Biochemistry 15(3):231-238.

Lange A, Bologna IR, Faroni CE, Trivelin PCO (2009) Aproveitamento pelo trigo do nitrogênio residual da crotalária (*Crotalaria juncea*) e uréia aplicado ao solo em cultivo precedente. Ciência Rural Santa Maria 39(6):1715-1720.

Malavolta E, Vitti GC, Oliveira AS (1997) Avaliação do estado nutricional das plantas: princípios e aplicações 2nd edn. POTAFOS. 319p.

Malavolta E (1987) Manual de calagem e adubação das principais culturas. Ceres. 496p.

Marur CJ, Ruano O (2001) A reference system for determination of cotton plant development. Revista de Oleaginosas e Fibrosas 5(2):243-247.

Moreira FMS, Siqueira JO (2006) Matéria Orgânica do Solo. In: Moreira FMS, Siqueira JO (Eds) Microbiologia e Bioquímica do Solo, 2nd edn, UFLA. p.203-261.

Perin A, Guerra JGM, Teixeira MG (2003) Cobertura do solo e acumulação de nutrientes pelo amendoim forrageiro Pesquisa Agropecuária Brasileira 38(7):791-796.

Silva NM, Raij B (1996) Fibrosas In: Raij B, Cantarella H, Quaggio JA, Furlani AMC (Eds) Recomendações de adubação e calagem para o Estado de São Paulo, 2nd edn, Instituto Agronômico/Fundação IAC. p261-273.

Zotarelli L (2000) Balanço de nitrogênio na rotação de culturas em sistema de plantio direto e convencional na região de Londrina-PR. UFRRJ (Tese de mestrado em Agronomia)