Title
Nutrient Content in Aboveground Biomass of Brazilian Peanut Cultivars in Conservation Tillage on Sugarcane Straw and Pasture Area

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Introduction

The area cultivated with peanut (*Arachis hypogaea* L.) in Brazil is approximately 115,000 ha (Conab, 2009), with 80 % in São Paulo State. In general, peanut has been grown in rotation with sugarcane (*Saccharum* spp.) or pasture and the cropping system is characterized by conventional tillage and adoption of short season cultivars (Bolonhezi et al., 2005). Nowadays green harvesting of sugarcane, as opposed to burning prior to harvesting, is practice on almost 50 % of the 4,2 million ha cultivated in Sao Paulo State. Due to the large amounts (on average 15 t of dry matter per hectare annually) of straw left on the soil surface after green cane harvest, tillage costs can increase up to 30 % compare to burning. Although in Brazil no-tillage systems are practiced on more than 26 Mio ha, studies about the role of peanut in sugarcane systems are scarce. Bolonhezi et al. (2007) reported no statistical difference in peanut pod and kernel yield, number of pods and pegs, between the conservation and conventional tillage following green harvested sugarcane. But this information is insufficient to develop a package of no-tillage technology for peanut, because the nutrient requirements of news cultivars could be different in conservation tillage as compared to conventional tillage of burned sugarcane. The aim of this study therefore was to determine the nutrient content concentration in vegetative parts of peanut cultivars, grown under different soil tillage systems in green harvested sugarcane and in pasture.

Materials and Methods

Three field experiments were carried out from 2004 to 2005 in two different types of soils, an Oxisol and an Ultisol, situated in Ribeirão Preto and Mirassol cities in Sao Paulo State. Main plot treatments in a split-plot experiment with four replications were conventional tillage (moldboard plowing followed by two applications of disk harrowing), minimum tillage (chisel plowing after spraying the area with 3.6 kg a.i. ha^{-1} of glyphosate), and no-tillage (crop residues on the soil surface after spraying of glyphosate). Sub-plots were the peanut cultivars IAC-Tatu (Valencia market-type, erect growth habit, red seed coat, maturity range around 100 days after planting) and IAC-Caiapó (runner market-type, prostate growth habit, pink testa, maturity range more than 135 days). The sowing dates of the experiment in rotation with sugarcane and pastures were 12/01/2004 (Ribeirão Preto) and 01/14/2005 (Mirassol). Prior to the onset of the trial, soil chemical characteristics were determined (0-20 cm) according to van Raij et al. (2001; Table 1).

Table 1. Chemical properties of surface soil (0-20 cm) of three experimental sites used for a sugarcane and pasture experiments in Sao Paulo State, Brazil.

Location	Straw	pH	O.M.	P (resin.)	K	Ca	Mg	H + Al	CTC	V
		$CaCl_2$	%	mg dm^{-3}	--------------$mmol_c$ dm^{-3}-------					%
Ribeirão Preto	Sugarcane	5.0	3.1	36	1.3	27	7.0	48	83.6	42
Ribeirão Preto	Pasture	5.1	3.2	17	1.5	22	12	34	69.8	51
Mirassol	Pasture	5.4	1.0	11	2.4	15	7	13	37.0	65

In each plot, plant samples (6 sampling times) were collected from 15 to 90 days after emergence (DAE) samples of plants in 2 meters of row. This aboveground biomass was oven-dried at 65 ^{o}C, weighted and ground to determine the concentration of macronutrients (N, P, K, Ca, Mg, and S) and micronutrients (Cu, Mn, and Zn) at the Soil Research Center of Agronomic Institute of Campinas according to Bataglia (1993). Basic fertilization in the sowing furrows consisted of 16, 70, and 40 kg ha^{-1} of N, P, and K, respectively. Data were subjected to ANOVA using ESTAT (UNESP, 1992), and means were separated using a Tukey t-test at $P<0.05$.

Results and Discussion

On Oxisol significant interactions between tillage and cultivar were found which depended on the date of evaluation. At Ribeirão Preto there were significant interactions between tillage systems and cultivars for Ca, S, and Zn concentration in peanut leaves for the first harvest (15 DAE). From 15 to 45 DAE, Zn concentration was higher in no-tillage compared to conventional tillage. The concentration of Zn was significantly higher ($P<0,05$) for IAC-Caiapó (59 mg kg^{-1} in not-till versus 47 mg kg^{-1} in conventional sugarcane system) at the first, for IAC-Tatu ST (46 mg kg^{-1} versus 35 mg kg^{-1}) at the second and for both of them at the third evaluation. In pasture plots at Ribeirão Preto, a significant interaction of genotype x tillage system was observed during the last evaluation, whereby for IAC-Caiapó the Zn concentration in no-tillage was 22 mg kg^{-1} compare to 16 mg kg^{-1} in conventional tillage, no such tillage effect was observed in IAC-Tatu.Overall, concentrations of Zn in peanut leaves cultivated in conventional tillage was below the level considered adequated by Gascho and Davis (1995). According to Cox (1990), a slight increase on the value of pH can lead to a decrease in leaf Zn concentration. Maybe in this experiment, the decomposition of sugarcane and pasture straw lead to an increase in soil pH, thereby affecting Zn uptake. The other reason could be the higher O.M. (%) in the soil under no-tillage systems (in average 0.7% higher) on sugarcane and pasture straw. Except for Mg and S in the experiment conducted at Mirassol (Table 2), the nutrient concentration in the aboveground biomassa of IAC-Caiapó was significantly higher than in the biomass of IAC-Tatu ST. On the other hand, tillage effects on the nutrient concentrations of peanut were only significant for S, Cu and Mn (Table 1). In the pasture plots on the Oxisol (Table 3), the concentrations of N, P, Cu and Zn in the aboveground biomass of IAC-Caiapó were significantly higher than in the biomass of IAC-Tatu ST. In the experiment carried out in rotation with sugarcane (Table 4), runner market-type peanut (IAC-Caiapó) showed significantly ($P<0,05$) higher concentration of N, P, K, Ca, S, Cu and Zn than the Valencia type one (IAC-Tatu ST). In general, the concentration of nutrients in the aboveground biomass of peanut were the greatest for N, followed by K, Ca, Mg, P, Mn, Zn, and Cu. These results agree with those mentioned by Gascho and Davis (1995) and Crusciol and Soratto (2008).

Conclusions

Early season data of peanut shoots showed significant interactions between tillage and cultivar for Zn concentrations. At 75 days after planting, the concentration of N, P, K, Cu, and Zn in the aboveground biomass of IAC-Caiapo is higher than IAC-Tatu, which showed higher concentrations of Ca, Mg, and S.

Table 2. Nutrient concentrations in aboveground biomass of peanut cultivars grown in rotation with pasture. Evaluation of 75 days after emergence, Mirassol, São Paulo State, Brazil.

Tillage Systems (T)	N	P	K	Ca	Mg	S	Cu	Mn	Zn
	----------------------------g.kg^{-1}					--------------------------	---------mg.kg^{-1}---------		
Conventional	26	1.7	19	13	4.3	1,7 a	6,2 ab	189 a	28
Minimum	24	1.8	17	12	4.4	1,4 b	5,7 b	176 ab	29
No-tillage	23	1.9	18	13	4.3	1,6 ab	6,5 a	165 b	31
F-probability	1.4 ns	1.9ns	1.5ns	1.3ns	0.1 ns	5.2*	5.8*	7.8 *	1.9ns
L.S.D. (Tukey 5%)	4.0	0.3	2.8	2.8	0.6	0.3	0.7	19	4,7
Cultivars (C)									
IAC-Tatu ST	21 b	1.6 b	17 b	14 a	4.4	1.5	4.9 b	157 b	25 b
IAC-Caiapó	28 a	2.0 a	19 a	11 b	4.2	1.6	7.3 a	197 a	34 a
F-probability	86**	219**	16 **	18 **	0,9 n s	2,6 ns	106**	11 **	40 **
L.S.D. (Tukey 5%)	2.0	0.1	1.2	1.3	0.4	0.1	0.5	28	3.4
Interaction T x C									
F-probability	3.8 ns	2.8 ns	0.9ns	0.3 ns	0.5 ns	0.8 ns	1.4ns	0.6 ns	0.3ns
C.V. (%) Tillage	10.5	9.8	10.2	14.3	8.3	11.1	7.0	6.9	10.3
C.V. (%) Cultivars	7.8	3.9	6.9	11.2	10.3	7.9	8.9	16.9	12.2

Table 3. Nutrient concentrations in aboveground biomass of peanut cultivars grown in rotation with pasture. Evaluation of 75 days after emergence, Ribeirão Preto, São Paulo State, Brazil.

Tillage Systems (T)	N	P	K	Ca	Mg	S	Cu	Mn	Zn
	---------------------------------g.kg^{-1}					-------------------------	---------mg.kg^{-1}---------		
Conventional	19	1.4	12 b	10.9	4.5	1.4	6.4	60	15 b
Minimum	20	1.6	15 ab	10.9	4.6	1.2	6.9	54	17 ab
No-tillage	21	1.6	18 a	11.4	4.7	1.3	7.4	62	18 a
F-probability	0.4 ns	2.6 ns	5.5 *	0.2 ns	0.2 ns	1.1 ns	2.0 ns	0.7 ns	6.9*
L.S.D. (Tukey 5%)	3.9	0.26	4.5	2.5	1.2	0.48	1.6	24.3	2.5
Cultivars (C)									
IAC-Tatu ST	17 b	1.3 b	15	11.7	4.5	1.3	6.0 b	56	14 b
IAC-Caiapó	23 a	1.8 a	15	10.6	4.6	1.4	7.8 a	62	19 a
F-probability	54 **	23 **	0.03ns	1.3 ns	0.01ns	1.4 ns	11.5**	0.79 ns	9.5*
L.S.D. (Tukey 5%)	17	0.2 ns	1.7	2.2	0.9	0.3	1.2	14.5	3.7
Interaction T x C									
F-probability	0.7 ns	0.6 ns	5.1 *	0.1 ns	0.46ns	0.1 ns	0.3 ns	0.24 ns	1.5 ns
C.V.(%) Tillage	12.9	11.0	19.3	14.5	16.5	23.4	14.7	26.9	9.8
C.V.(%) Cultivars	9.5	17.4	12.0	21.2	21.0	20.1	18.9	26.7	23.9

Table 4. Nutrient concentrations in aboveground biomass of peanut cultivars grown in rotation with green harvested sugarcane. Evaluation of 75 days after emergence, Ribeirão Preto, São Paulo State, Brazil.

Tillage Systems (T)	N	P	K	Ca	Mg	S	Cu	Mn	Zn
	---------------------------------g.kg^{-1}---------------------------						---------mg.kg^{-1}---------		
Conventional	19	1.7	17	13	3.7	1.9	7.4	81	20 b
Minimum	19	1.6	18	13	3.7	1.9	6.7	79	22 ab
No-tillage	21	1.8	16	14	4.2	2.1	7.1	94	25 a
F-probability	0.9 ns	2.1 ns	1.9 ns	0.5 ns	1.0 ns	2.4 ns	0.7 ns	5.1ns	11.4 **
L.S.D. (Tukey 5%)	3,2	0,8	3,5	2,0	1,1	0,3	1,7	15,5	3,3
Cultivars (C)									
IAC-Tatu ST	17 b	1.4 b	15 b	15 a	3.7	2.1 a	6.0 b	85	19 b
IAC-Caiapó	23 a	2.0 a	18 a	13 b	4.0	1.8 b	8.1 a	86	26 a
F-probability	32 **	71.4**	23 **	12 **	1.5 ns	13.4**	86 **	0.01ns	11.5 **
L.S.D.(Tukey 5%)	2.4	0.2	1.4	1.3	0.5	0.1	0.5	0.4	4.3
Interaction T x C									
F-probability	0.1 ns	0.02ns	0.4 ns	1.4 ns	1.2 ns	1.3 ns	0.2 ns	0.4 ns	0.2 ns
C.V. (%) Tillage	10.3	10.9	13.4	9.8	18.1	11.5	15.4	11.9	9.4
C.V. (%) Cultivars	12.9	10.9	9.2	10.1	14.9	7.9	7.9	17.3	20.7

Reference

Bataglia OC., Furlani, MAC, Teixeira JPF, Furlani PR, Gallo JR., Métodos de análise química de plantas, Campinas, Instituto Agronômico, 48 p, 1983. (Boletim Técnico, 78).

Bolonhezi D, Santos RC dos, Godoy IJ de. Manejo cultural do amendoim. In: Santos RC dos ed. O agronegócio do amendoim no Brasil. Campina Grande: EMBRAPA Algodão, 2005193-244.

Bolonhezi D, Mutton AM, Martins ALM, Sistemas conservacionistas de manejo do solo para amendoim cultivado em sucessão à cana crua. Pesq. Agropec. Bras. 2007;42(7):939-947.

Cox, FR.. A note on the effect of soil reaction on zinc concentration on peanut tissue zinc. Peanut Science. 1990;17:15-17.

Conab, Conselho Nacional de Abastecimento. Available at: http//www.conab.gov.br/safras.asp. Accessed May 18, 2009.

Crusciol ACC, Soratto RP, Nitrogen supply for cover crops and effects on peanut grown in sucession under a no-till system. Agronomy Journal. 2008; 100(6):1-6.

Gascho GJ, Davis JG. Soil fertility and plant nutrition. In: Patee HE, Stalker HT,ed. Advances in Peanut Science. Stillwater : American Peanut Research and Education Society; 1995:383 - 419.

Raij, B. van, Cantarella H, Quaggi JA, Furlani AMC. Recomendações de adubação e calagem para o estado de São Paulo. Campinas, Instituto Agronômico & Fundação IAC, 1997;285 p. (Boletim Técnico, 100).