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APPLICATION OF DIFFERENT COMBINATION OF CALCIUM NITRATE AND UREA TROUGH IRRIGATION WATER TO BANANA CROP

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ABSTRACT: The objective of the work was to evaluate the effect of different combinations of two nitrogen sources applied by fertirrigation on the yield of cv. Grande Naine banana and on benefit-cost relationship during the first and second production cycle. The experiment followed a random block design with five replications, where six complementary percentages of urea and nitrate were applied by irrigation water in a drip irrigation system. Bunch productivity, number of fruit per bunch, fruit length and diameter of the second bunch were evaluated. A cost analysis of nitrogen sources for the different combination (treatments) was carried for evaluating variable cost, gross income and gross margin. The mean fertilizer prices were collected in thew region in December, 2007. There was no effect of combination of nitrogen sources on means of yield of bunches, average number of fruits per bunch and average length of fruit of the second bunch. The increase in calcium nitrate in the combination of nitrogen sources induces a reduction on gross margin (profits) for the farmer.

KEYWORDS: Fertirrigation, Productivity, gross margin

IINTRODUCTION: Nitrogen is one of the most important for banana crop growth due to its large amount uptaken and exported by fruits (BORGES et al, 1997; SILVA et al., 1999). The nitrogen sources quickly available are inorganic salts of ammonium, nitrate and urea, in wich the more used ones are urea and ammonium (BARBOSA FILHO et al., 2004). However, the use of these sources requires that techniques of management application be improved in such a way that farmers may be obtain maximum economical benefit when using these fertilizers. The use of ammoniacal sources, despite the smaller cost, shows a disadvantage concerning the possibility of reduction on soil pH and basis saturation reducing availability of soil nutrients due to nitrification process in the soil that liberates H+ ions (SILVA & VALE, 2000). One way to overcoming this problem may be the use of an ammoniacal source combined with nitric source in such a way that effects on soil acidity may be minimized. This work had as objective to analyze yield and fertilizer costs for different combination of two nitrogen sources (calcium nitrate and urea) applied by fertirrigation on 'Grand Naine' banana during two crop cycles.

MATERIAIS E METODOS: The work was carried in a experimental field of Embrapa Cassava & Tropical Fruits, at Cruz das Almas city, Bahia State (12º48`S; 39°06`W; 225m), whose climate is classified as humid to sub humid with 1.143mm of rain per year (D`Angiolella et al., 1998). Banana cv. Grand Naine was cultivated for two crop cycles in a Alic Yellow Latossol (Souza & Souza, 2001) and was irrigated by a drip system with 4 Lh-1 emitters (three per plant). The chemical soil characteristics are shown in Table 1. Banana was cultivated in single rows with 2,5 x 3,5 m spacing.

The experiment follow a random block design with five treatments and five replications with six useful plants per plot. The used sources for fertirrigation were urea (amidic source) and calcium nitrate (nitric source). These sources were combined concerning the period of cycle in which it was applied. Treatments were: T1-100% of the whole cycle with urea; T2-80% of the whole cycle with urea and 20% with calcium nitrate; T3-60% of the whole cycle with urea and 40% with calcium nitrate; T4-40% of the whole cycle with urea and 60% with calcium nitrate; T5-20% of the whole cycle with urea and 80% with calcium nitrate; T6-100% of the whole cycle with calcium nitrate.

Table 1: Average values of soil chemical characteristics of the experimental area.

Depth	pH	P	K	Ca	Mg	Na	S	CTC	V	M.O.
(m)	(H2O)	(mg dm-3)				(mol dm-3)			%	g kg-¹
0-0.2	5,17	4,33	0,26	1,17	1,27	0,14	2,83	5,95	47	7,54
0.2-0.4	5,27	4,33	0,33	1,30	1,07	0,15	2,85	5,85	48	7,31

These sources were combined concerning the period of cycle in which it was applied. Treatments were: T1-100% of the whole cycle with urea; T2-80% of the whole cycle with urea and 20% with calcium nitrate; T3-60% of the whole cycle with urea and 40% with calcium nitrate; T4-40% of the whole cycle with urea and 60% with calcium nitrate; T5-20% of the whole cycle with urea and 80% with calcium nitrate; T6-100% of the whole cycle with calcium nitrate. The experimental area received 1600 kg.ha-¹ of limestone. Fertilizers were applied according to recommendations of Borges & Costa (2002), in which nitrogen and potassium were applied by fertirrigation in a frequency of two days a week. Fertirrigation was performed by using a hydraulic pump (TMB 60) at the manifold installed in the beginning of the area and treatments were differentiated by six valves, each one corresponded to a treatment. Bunch productivity, number of fruit per bunch, fruit length and diameter of the second bunch were evaluated. The yield data were submitted to a variance analysis by using statistical software (SAS, 2000). A cost analysis of nitrogen sources for the different combination (treatments) was carried for evaluating variable cost, gross income and gross margin. The mean fertilizer prices were collected in thew region in December, 2007. The mean price got by a farmer was R$ 0,30/kg in December, 2007, values that was used in order to calculate economic indexes for banana crop.

RESULTS AND DISCUSSION: The average bunch productivity varied from 19.17 t ha^{-1} to 21.10 t ha^{-1} at the end of the first cycle. These values were considered smaller than the expected due to problems in the beginning of the first cycle. Yields got a maximum of 42.2 t ha-¹, value near the one obtained by Melo et al (2001) who got 48 t ha-¹. The was no effect of combination of nitrogen sources on yields of the crop, but larger productivities were obtained for treatments with larger percentages of nitrate. The mean fruit diameter of the second bunch was influenced by nitrogen sources combination. Treatment T6 differed from T1 and showed the largest values of fruit diameter (0.037 m), while T1 showed the smalest average of all treatments (0.037 m). The largest absolute values of productivity, lenght and fruit diameter were obtained for T6 (Table 2) despite the fact of non-significance of variance analysis. The variable fertilizer cost raises up according to increase of calcium nitrate (Table 3) reaching values up to 760% larger than the cost when using urea only during the whole cycle. As a consequence, the gross margin determined by the difference between gross income and the variable cost is smaller when only calcium nitrate is considered (T1= R$/ha 15.48) being the half of gross margin obtained with unique application of urea. This difference is due to the larger cost of calcium nitrate compared to urea. In order to get a gross margin obtained by T1 it is necessary an increase in yields of 11, 17, 14, 45 and 44% on treatments T2, T3, T4, T5 and T6, respectively..

Table 2 – Mean productivity of bunches, mean number of fruits per bunch, average length and diameter of fruit of second bunch for the different combination of urea and calcium nitrate.

Treatment	Mean productivity of bunches (t ha-¹)		Mean number of fruits per bunch		Length of fruit of 2º bunch (m)		Diameter of fruit of 2º bunch (m)	
	1º cycle	2º cycle	1º cycle	2º cycle	1º cycle	2º cycle	1º cycle	2º cycle
T1	19,41ns	36,56ns	91,2ns	176,0ns	0,2028ns	0,216 ns	0,0347 b	0,0376ns
T2	19,17ns	35,24ns	91,2ns	162,0ns	0,2188ns	0,221 ns	0,0366 a	0,0370ns
T3	20,59ns	35,96ns	102,8ns	174,5ns	0,2166ns	0,211 ns	0,0358 ab	0,0379ns
T4	19,46ns	42,22ns	93,8ns	154,2ns	0,2178ns	0,225 ns	0,0358 ab	0,0373ns
T5	19,86ns	36,68ns	96,0ns	163,0ns	0,2134ns	0,216 ns	0,0362 ab	0,0375ns
T6	21,10ns	37,78ns	91,8ns	178,5ns	0,2,98ns	0,218 ns	0,0374 a	0,0376ns

ns – non significative at 5% probability
Means followed by the same letters do not differ among them at 5% probability by Tukey test.

Table 3. Variable cost (R$/ha), mean yield (t/ha), gross income (R$/ha) and gross margin (R$/ha), values collected in december/2007.

Treatment	Variable cost ($R\$.ha^{-1}$)	Mean yield ($t.ha^{-1}$)	Price ($R\$.t^{-1}$)	Gross income ($R\$.ha^{-1}$)	Gross margin ($R\$.ha^{-1}$)
1	1.311	55,97	300	16.791	15.480
2	2.563	54,42	300	16.327	13.764
3	4.445	56,56	300	16.968	12.523
4	5.698	61,68	300	18.505	12.807
5	8.369	54,55	300	16.364	7.995
6	9.962	58,89	300	17.666	7.705

The increase in variable costs induces a reduction on gross margin, but farmer wants to increase income and to reduce costs. Treatments with less calcium nitrate in combination were the ones with less variable cost, therefore the more urea in the combination the more increase in gross margin or benefit-cost relation. Therefore T1 becomes the most adequate alternative for application of nitrogen sources if economic aspects only are considered.

CONCLUSIONS: There was no effect of combination of nitrogen sources on means of yield of bunches, average number of fruits per bunch and average length of fruit of the second bunch. The increase in calcium nitrate in the combination of nitrogen sources induces a reduction on gross margin (profits) for the farmer.

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